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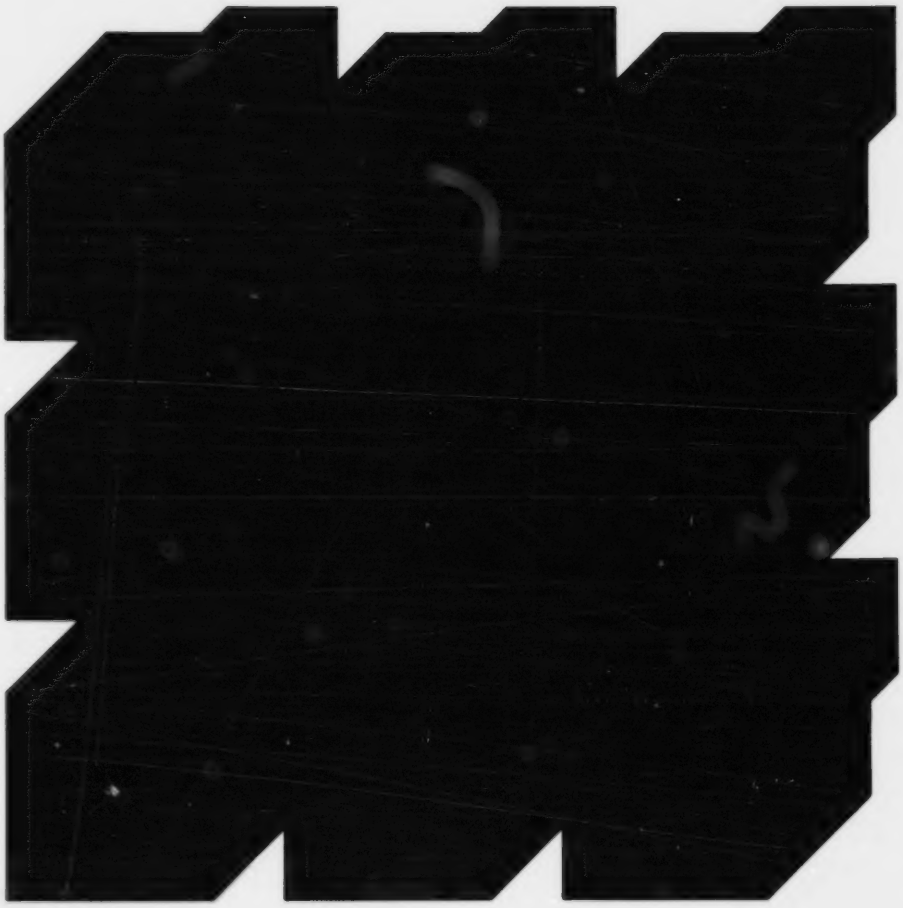

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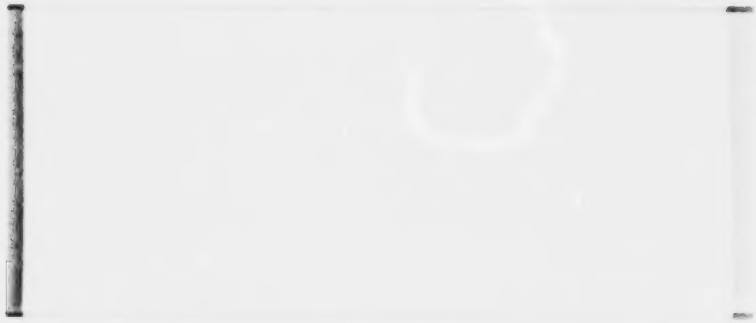

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DISCUSSION PAPER NO. 303

The Potash Corporation of Saskatchewan: An Assessment of the Creation and Performance of a Crown Corporation

by Nancy Olewiler

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RÉSUMÉ

La Saskatchewan est la plus grande exportatrice de potasse au monde, et elle possède des ressources pouvant encore satisfaire à la demande mondiale pour plusieurs milliers d'années. Les gisements de la Saskatchewan ont d'abord été mis en valeur par le secteur privé. Mais en raison de conflits multiples et complexes aux plans économique, politique et juridique entre les producteurs de potasse et le gouvernement de la Saskatchewan, celui-ci a créé une société d'État, la Potash Corporation of Saskatchewan (PCS) en 1975. Le gouvernement provincial a dès lors commencé à acheter les mines actives situées dans la province de sorte que, en 1978, il en possédait trois, détenait des intérêts dans deux autres, et était devenu le plus grand producteur de potasse du marché nord-américain. En 1984, la société détenait plus de 30 % de la production et des ventes de la Saskatchewan en Amérique du Nord.

Dans cette étude, l'auteur : a) présente un tableau des marchés internationaux de potasse au cours des vingt dernières années, b) décrit la création de la PCS, c) évalue son rendement, d) se demande s'il était nécessaire de créer une société d'État pour réaliser les objectifs poursuivis par le gouvernement de la Saskatchewan, et e) procède à un examen théorique des options politiques et des instruments dont dispose le gouvernement provincial dans l'exploitation de la PCS.

L'industrie internationale de la potasse réunit très peu de producteurs et, à l'exception des États-Unis et de l'Allemagne de l'Ouest, tous les autres producteurs de potasse se caractérisent par un certain degré de propriété gouvernementale. Au plan mondial, l'intervention de l'État dans l'industrie de la potasse n'est donc pas inusitée. Dans le cas de la Saskatchewan, comme nous l'avons dit, une série d'événements complexes ont mené à la formation de la PCS. Au cours des quinze dernières années, le gouvernement provincial s'est employé à réglementer cette industrie. Il semble que ses objectifs principaux aient été d'en promouvoir la croissance, de stabiliser les prix et la production en vue des revers du marché et d'obtenir une part des redevances potassières. Au milieu des années 70, une série d'actions en justice, fondées sur la Constitution, s'opposait au recours par le gouvernement de la Saskatchewan à des instruments classiques d'intervention, comme la fiscalité et le contingentement (restriction de la production), de sorte que le gouvernement a trouvé difficile de réaliser ses objectifs. Ces événements, sans compter les très mauvais rapports avec les producteurs de potasse et la volonté politique de s'accaparer d'une part du secteur privé, ont mené à la mainmise gouvernementale d'une large part de l'industrie.

En 1978, la PCS était un grand producteur de potasse. L'auteure utilise toutes sortes de techniques pour évaluer son rendement. À l'aide des indicateurs financiers habituels, comme le taux des bénéfices, elle compare la PCS à d'autres producteurs du secteur privé pour lesquels il disposait de données. Elle fait cette comparaison mine par mine, de sorte que le rendement des mines administrées par la PCS puisse être évalué avant et après le changement de propriétaire. La PCS a permis à la province de recouvrer des redevances appréciables. Bien que les années 1982 et 1983 aient été déplorables, la période allant de 1978 à 1981 a été extrêmement profitable, puis des bénéfices modestes ont recommencé à être enregistrés en 1984. Une évaluation du rapport investissement-bénéfices dans les mines de potasse montre également que la PCS est une entreprise rentable. Elle se compare avantageusement à plusieurs de ses homologues du secteur privé. La Société cherche également à réaliser certains objectifs sociaux plus généraux, ce qui la différencie des producteurs privés. Parmi ces objectifs, notons la stabilisation des emplois, l'attribution d'une plus grande part des revenus de vente que dans le secteur privé à la recherche et au développement, et les mesures de protection de l'environnement, ainsi que de la santé et de la sécurité des travailleurs. L'auteure conclut que les citoyens de la Saskatchewan ont nettement bénéficié de la PCS.

L'auteure applique les diverses hypothèses d'équilibre d'un modèle oligopolistique théorique pour déterminer si la PCS est encouragée à se comporter différemment des sociétés privées évoluant dans le même milieu. L'examen porte sur le marché nord-américain. À la lumière de l'information "stylisée" sur l'industrie potassière en Saskatchewan, on peut dire que l'entreprise d'État n'a pas vraiment intérêt à s'éloigner de l'équilibre non coopératif Nash-Cournot. L'analyse de l'information sur la part du marché dont jouit la PCS par opposition aux autres producteurs, ainsi que de certains autres éléments d'information, montre qu'il n'y a eu aucune modification importante ou soutenue du comportement oligopolistique depuis la création de la PCS.

Enfin, la création de la PCS a permis au gouvernement provincial de recourir à deux instruments de perception des redevances et de contrôle de la production : la fiscalité et le contingentement. D'après le modèle oligopolistique, la combinaison de la production de la PCS et du revenu d'impôt qui maximise les redevances au gouvernement est déterminée par d'autres hypothèses d'équilibre. L'analyse montre le volume hypothétique maximal des redevances potassières selon différents équilibres et taux d'imposition. La masse de redevances revenant au gouvernement et aux producteurs privés est à son plus haut niveau dans le cas d'un équilibre coopératif, puis diminue à mesure que l'on se dirige vers l'équilibre Nash et Stackelberg. Les compromis décrits pourraient aider à la formulation d'une stratégie à long terme pour la PCS.

ABSTRACT

Saskatchewan is the largest exporter of potash in the world, with resources sufficient to satisfy world demand for several thousand years. The Saskatchewan deposts were developed initially by the private sector. Due to a variety of complex economic, political, and legal conflicts between the private-sector potash producers and the provincial government, the Government of Saskatchewan established a crown corporation, the Potash Corporation of Saskatchewan (PCS) in 1975. The provincial government began buying producing mines located in the province, and by 1978 had acquired three mines, had interests in two other mines, and was the largest single producer of potash in the North American market. By 1984, PCS accounted for over 30 per cent of both Saskatchewan output and sales in North America.

This study: (a) presents an overview of international potash markets over the past 20 years, (b) describes the formation of PCS, (c) evaluates its past performance, (d) considers whether a crown corporation was required to achieve the stated policy objectives of the Government of Saskatchewan, and (e) examines in theory the possible policy options and instruments available to the provincial government in the operation of PCS.

The international potash industry consists of relatively few producers, and with the exception of the United States and West Germany, all other potash-producing countries have some degree of government ownership. Government presence in the world potash industry is thus not unusual. In the case of Saskatchewan, a series of complex events led to the formation of PCS. Throughout the past 15 years, the provincial government has been active in regulating its potash industry. The major objectives of the government appear to have been to promote growth in the industry, to stabilizes prices and outputs during adverse market conditions, and to obtain a share of the mineral rents from potash. In the mid-1970s, a series of constitutional challenges to the Government of Saskatchewan's ability to use traditional policy instruments such as taxation and prorationing (output restrictions) restricted their ability to meet these objectives. This, combined with an acrimonious relationship with the potash producers and a political philosophy of government participation in the private sector led tot he takeover of a substantial proportion of the industry.

By 1978, PCS was a major producer of potash. To evaluate its performance, a variety of techniques are used. With standard financial indicators such as ratios of profitability, PCS is compared to those private-sector producers for which data was available. This is done on a mine-by-mine basis, so that the

performance of the mines that constitute PCS can be evaluated both before and after the change in ownership. PCS has generated fairly substantial rents to the province. While 1982 and 1983 were poor years, the period from 1978 to 1981 was extremely profitable, and in 1984 a modest profit was realized. An evaluation of the return on the investment in potash mines also shows that PCS has been a profitable company. PCS thus compares well with a number of its private-sector counterparts. PCS also is pursuing some broader social objectives that differentiate it from a private producer. These include employment stabilization, devotion of a larger share of sales revenues to research and development than observed for the private producers, and concern for environmental protection and the health and safety of workers. The study finds that PCS has generated positive net benefits to the residents of Saskatchewan.

A theoretical model of oligopoly is solved under different equilibrium assumptions to see if PCS has an incentive to behave differently from a private firm operating in the same environment. The focus is on the North American market. Given the "stylized facts" for the Saskatchewan potash industry, it is found that there is little incentive for the crown corporation to deviate from a Nash-Cournot non-cooperative equilibrium. In assessing information about market shares of PCS versus other producers and other evidence, it appears that no major and sustained change in oligopoly behavior has occurred since the creation of PCS.

Finally, the creation of PCS has given the provincial government two policy instruments with which to collect rents and influence production - taxation and PCS output. Using the theoretical oligopoly model, the combination of PCS output and taxes that maximizes the government's rents is determined under different equilibrium assumptions. The analysis illustrates the hypothetical maximum size of the potash rents under different equilibria and tax rates. Aggregate rents to the government and private-sector producers are greatest under a cooperative equilibrium, then decline as one moves to the Nash and Stackelberg equilibria. The tradeoffs illustrated could help design a long-term strategy for PCS.

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1 INTRODUCTION

The province of Saskatchewan is a relatively recent arrival in the world potash industry. Its large potash deposits remained undiscovered until 1943 and no significant production took place until 1962. Now Saskatchewan is the world's second largest producer (next to the U.S.S.R.) and has the largest proven stocks of potash, sufficient to satisfy world demand for several thousand years. The Saskatchewan deposits were developed initially by the private sector. Then, due to a variety of complex economic, political, and legal conflicts between the private-sector potash producers and the provincial government, the Government of Saskatchewan established a crown corporation, the Potash Corporation of Saskatchewan (PCS), in 1975. The government then began buying producing mines located in the province. By 1978, the provincial government had acquired three mines, had interests in two other mines, and was the largest single producer of potash in the North American market. By 1984 PCS accounted for over 30 per cent of Saskatchewan potash output, and approximately 30 per cent of sales in North America.

A study of the Potash Corporation of Saskatchewan is important for a number of reasons. Potash is a mineral commodity that is capable of generating rent from the owners of potash deposits. This rent has played an important role in the formation of PCS, as

we will see in Part 3 of this paper. Who has the rights to this rent and how it will be shared between the owner of the deposit and the residents of Saskatchewan has been a debatable issue. Potash is primarily an export good. Only about 16 per cent of the potash produced in Saskatchewan is consumed in Canada. The rest is exported to the United States and various offshore markets (see Part 2 for details on markets). Therefore, many of the potential conflicts between consumer and producer welfare are avoided for potash. Unlike many government enterprises, PCS provides few goods and services to Canadian consumers.

The circumstances surrounding the creation of PCS are somewhat unique. A combination of constitutional conflicts between the provincial and federal levels of government and the provincial government versus the private sector potash producers in Saskatchewan, combined with a political philosophy sympathetic to government enterprise, led to the creation of PCS. PCS is quite different from, for example, PetroCanada, de Havilland, hydroelectric crown corporations, and other well-known enterprises. PCS has been a relatively profitable firm. It appears to be following profit-maximizing strategies very similar to those of its private sector counterparts. Finally, if PCS remains a government enterprise, there is potential to increase the rents generated by Saskatchewan potash. The industry has acted as an uncoordinated oligopoly in the past. If PCS could use its potential market power to coordinate some actions within the industry,

it is possible that Saskatchewan's share of the world rents from potash can increase. These points will be highlighted in various sections of the paper.

This research project has two main objectives: (1) to describe the formation of PCS, and (2) to evaluate the performance of PCS and consider whether a Crown corporation was required to achieve the government's stated policy objectives. As part of the second objective, I will also examine, in theory, the possible policy options and instruments available to the Saskatchewan government in the operation of PCS and coordination of the Saskatchewan industry.

The paper is organized as follows. Before discussing the formation of PCS, an overview of the international potash industry is presented in Section 2. The structure of the industry, potential supply over time, and the various markets for potash are examined. The events leading up to the formation of PCS are considered in Section 3. As there have been many discussions of the creation of PCS, this section will not be extensive. A detailed evaluation of the Potash Corporation follows in Part 4. Various measures of financial performance are presented which compare (when possible) PCS to private-sector potash firms. I also examine the operation of the mines which make up PCS before and after their purchase by the government. For this discussion, I address in the last section the question of whether managers of PCS are following

different objectives than those of their private sector counterparts. This is done using the financial data and also a theoretical model which examines potential objective functions for a large government firm in an oligopoly. An important feature of the model is that the government has two policy instruments for affecting the industry and collecting resource rents -- taxation, the traditional instrument of governments, and the output and pricing decisions of its potash firm, the new policy instrument. The theoretical model will be used to examine past behavior of PCS and also to include some possible future options.

2 THE POTASH INDUSTRY

Potash is the source of potassium, which, along with nitrogen and phosphorus, is one of the essential components of fertilizers. Potassium enables plants to withstand adverse growing conditions, promotes root growth, stiffens cereal grains, and aids in the synthesis of starch and sugar.[1] In this section, I examine: (1) the characteristics of potash supply from both Saskatchewan and the rest of the world, (2) the markets for Saskatchewan potash, and (3) activities in the market over the past 15 years.

The international potash industry consists of relatively few producers, and has a substantial degree of public ownership. The major potash-producing countries are Canada, the U.S.S.R., the United States, East and West Germany, France, Italy, Israel, Jordan, and Spain. Some other countries are developing potash deposits, notably, Brazil, which plans to open its first mine this year or next, China, Indonesia, Australia, and Thailand. In North America, there are about twelve private-sector producers. With the exception of the United States and West Germany, all other potash-producing countries have some degree of government ownership.[2] And, except for the United States, every nation that exports potash uses a single selling agency. In Canada, this agency is Canpotex, a producers' association that consists of all

the Saskatchewan producers, including PCS. Canpotex is responsible for all potash sales outside North America.

In the past, a number of potash cartels have operated. Germany and France formed a cartel in 1924, dividing their share of the export market so that Germany got 70 per cent and France 30 per cent. The cartel was gradually weakened over time by the entry of new producers in Poland, Spain, the U.S.S.R., the U.S.A., and Palestine. By the end of World War II, the cartel was effectively eliminated. But ownership was still concentrated in few firms. In West Germany, there were three private sector firms whose sales were handled by one agency (now there are two). All the French mines were integrated with the government-owned mines. Sales of potash from Spain were handled by one agency. Of course, all potash from the U.S.S.R. and its eastern bloc were under government control.

Canada opened its first potash mines in the early 1960s, and the potash industry was changed significantly. The productive capacity of the Saskatchewan mines quickly became the largest in world. Between 1962 and 1972, virtually all the potash mines that currently operate in Saskatchewan were constructed, and what had been an "orderly" market fell into disarray. The industry could be characterized by the beginning of the 1970s as an uncoordinated oligopoly. The huge increase in world production brought about by Saskatchewan's mines, together with a dampening in demand, led to a period in the early 1970s of very low prices and substantial

excess capacity. The overcapacity was ultimately controlled by agreement between the Saskatchewan and U.S. governments to limit production and establish a price floor. These measures were dropped by the mid-1970s when potash markets recovered and prices rose. The formation of PCS in 1975 has again concentrated potash capacity in fewer hands. The formation of Canpotex has also led to a coordination of all potash sales from Saskatchewan producers to "offshore" markets -- those outside of North America. But, we have yet to see a move to a coordinated oligopoly in Saskatchewan's most important market -- the United States. This is of course due to legal difficulties -- U.S. anti-trust legislation. But even if we could ignore these legal problems, I argue in Section 5 that formation of a partial cartel of Saskatchewan producers is unlikely to be in Saskatchewan's interests in the current environment.

Potash is basically a homogeneous good. There are differences in ore grades among the mines, but the final products from each mine and mill operation are virtually identical. Potash output is either expressed in terms of potassium chloride (KCl) or as K_2O which is about 60 to 62 per cent of KCl in Saskatchewan. I will use both KCl and K_2O units in this paper, as the industry reports both measures. There are differences in the geological formations that produce potash which give rise to different ore grades and, hence, extraction costs. Potash in Saskatchewan is extracted from sylvinite ores (consisting of potassium chloride and sodium

chloride). The per cent of K_2O in these sylvinite ores ranges from 20 to 35 per cent. Other countries such as the U.S.A., the U.S.S.R., Germany, and France also have sylvinite deposits, but they are typically of a lower grade than those in Saskatchewan. By contrast, the K_2O content of the different types of ores yielding potash in other parts of the world ranges from a low of 7 per cent to a high of 20 per cent.

As a result of favourable geology, Saskatchewan's production costs are generally the lowest in the world. Sheldrick (1983) estimates that the average cost per metric ton of KCl produced in Canada (for a mine with a capacity of 1.36 million metric tons[3] KCl) was $24 per tonne (1982 U.S. dollars) for the operating costs of the mine and refinery before depreciation and taxation. Production costs, including taxes and depreciation, are about $40 per tonne KCl. I have estimated a series of average costs curves for various Saskatchewan mines and found that for most mines, average operating costs are U-shaped with a relatively large region of constant unit costs. For example, for relatively low-cost mines in Saskatchewan, capable of producing between 450,000 and 600,000 tonnes K_2O per year, average costs would be between $14 and $21. For a larger operation (500,000 - 800,000 tonnes per year), average costs would be somewhat lower. The average costs reported here are in real terms, deflated by the Canadian industry selling price index for all manufactured materials (1971 = 100). The costs include all mine and mill

operating costs exclusive of taxation and depreciation.[4] If the mine and mill operate at full capacity, average costs would be between $12.50 and $20 in 1971 Canadian dollars, or between $30 and $48 per tonne K_2O ($18 to $30 per tonne KCl) in 1982 U.S. dollars.

I do not have good information on the average costs of individual mines outside of Saskatchewan, but some studies claim that Saskatchewan's production costs are lower than those of any other producer. An Energy, Mines and Resources study of potash (1982) estimated that operating costs per tonne KCl (in 1978 dollars) were about $14 to $16 dollars for Saskatchewan, compared to $22 to $24 for U.S. producers, and over $30 for European producers. In 1982 dollars, these figures would come to $21, $33, $43 for the three regions respectively. Sheldrick (1978) also reported operating costs for a typical New Mexican potash deposit at about $21 per short ton of KCl ($23 per tonne, or about $33 per tonne K_2O). Some more recent estimates by industry observers put U.S. costs higher than these figures ($60-77 per tonne K_2O in 1984 U.S. dollars). This is due to declining ore grades in U.S. mines. Table 1 gives estimates of production costs and freight rates for Canada's competitors.

To compare the numbers in Table 1 to Saskatchewan potash costs, other charges must be incorporated. Including depreciation (5 per cent), insurance and local taxes, and a 15 per cent capital

Table 1

Production Costs and Freight Rates for Potash Producers Outside of Saskatchewan, per tonne K_2O

Country	Production Cost Range	Domestic Freight Charges	Total Cost FOB
U.S.A.	$ 65 - 71	$ 26 - 27	$ 91 - 98
Eastern Canada	75 - 85	8 - 10	83 - 95
West Germany	80 - 90	15 - 25	95 - 115
France	90 - 100	20 - 25	110 - 125
Spain	80 - 95	6	86 - 101
United Kingdom	90 - 95	4 - 5	94 - 100
U.S.S.R.	50 - 55	15 - 20	65 - 75
East Germany	50 - 55	15 - 20	65 - 75
Israel	68 - 83	6 - 7	74 - 90
Jordan	75 - 90	9 - 10	84 - 100

Source Province of Saskatchewan. (Not to be quoted without permission).

charge, Sheldrick (1983) comes up with an average cost of about $83 per tonne KCl or $50 per tonne K_2O for his hypothetical Canadian mine. The calculations are based on a total investment in this mine with 1.364 million tonnes capacity KCl of about $386 million in 1982 U.S. dollars. Actual capital costs have, of course, varied considerably over time, and Sheldrick's numbers refer to a mine commencing extraction in 1982. Historically, real capital costs have been lower than this figure. To get an idea of what it costs to expand capacity, we can look at the capital costs at two mines -- PCS's Lanigan operation and Kalium's Belle Plaine mine. At Lanigan, an expansion will take capacity from 1.022 to 2.928 million tonnes KCl. The project is slated for completion in 1985 at a cost of at least $435 million (Canadian). Kalium (which operates Saskatchewan's two solution mines) plans to increase its rated capacity by 25 per cent to about 1.089 million tonnes K_2O. The cost estimate for this expansion is $100 million (Chorley, 1984). This means that the capital cost per million tonnes KCl ranges from $221 million at Kalium to $228 million at Lanigan ($368 to $380 million tonnes K_2O).

Transportation charges can be substantial for Saskatchewan and all potash producers (as illustrated in Table 1). Sheldrick and PCS estimate transportation costs at about $31 per tonne KCl (1982 U.S. dollars) FOB from Vancouver. Transportation costs from Saskatchewn to the major U.S. markets vary between $42 and $62 per

tonne KCl (1983-84 dollars) depending on the type of transportation. A combination of unit trains plus barge lies at the low end of costs, while single railroad cars direct to the buyer are at the upper end. Using the transportation charges for the offshore sales (from Vancouver), this would bring Saskatchewan's costs up to about $114 per tonne KCl including the capital charge of $32. Without the capital charge, the average cost comes to about $71 per tonne KCl. Sheldrick's figures do not include provincial and federal taxes. As we will see below, these taxes are different for PCS than for the private sector firms (PCS pays no federal taxes). The taxes have also changed dramatically over time. Thus, while Saskatchewan producers still enjoy cost advantages over most of their competitors, the transportation charges and taxes can limit their ability to compete with foreign producers in certain markets.

The market for Saskatchewan potash consists primarily of the United States and Pacific Rim countries. Only about 5 per cent of the potash produced in Canada is consumed domestically. Typically, over 70 per cent of its exports go to the United States, primarily to the midwest grain belt. The demand for potash in North America is relatively inelastic. I have estimated a North American demand curve and found the long-run price elasticity to be about -.36. This inelasticity is due to the heavy use of chemical fertilizers per acre of arable land. The more intensively land is cultivated, the greater the need for fertilizer.

The major "offshore" markets for Saskatchewan potash include countries such as China, Japan, India, Belgium, Korea, and Australia. Table 2 shows potash sales in both North America and offshore for the past 11 years. I have estimated demand curves for potash for some of Canada's offshore buyers. Unfortunately, data limitations prevent the estimation of demand for many countries (including China and India). In the literature for potash, there is conjecture that potash demand is more price elastic in these offshore markets. The reason is that many of the buyers are farmers in less developed economies who have, in the past, relied on non-chemical fertilizers (animal waste, for example) and have farmed extensively rather than intensively. In my examination of separate countries, I find some support for this, but the results are not uniform. For Ireland (a country of lower GNP per capita than Belgium), price elasticity is -.81, while that for Belgium is -.15. However, Japan has a price elasticity of -.77, while those for Korea and Mexico are around -.3.

Estimates of price elasticity can be useful in evaluating the performance of PCS. If there is a significant difference between price elasticities between the two major markets, it suggests that some sort of price discrimination may be feasible. Indeed, we do observe a price differential between North America and offshore that is not accounted for simply by differences in transportation costs. Potash seems to be priced higher in the offshore market during booms and lower during recessions. This would seem

Table 2

Canadian Potash Production and Sales, thousands of tonnes K_2O

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984**
Production	4,249.0	5,495.2	5,435.2	4,995.9	6,088.6	6,123.5	6,714.7	7,300.2	7,174.6	5,207.9	5,928.4	7,875.0
Sales												
Domestic	192.7	266.8	227.7	248.8	249.2	370.0	379.0	377.7	331.6	272.8	384.9	
United States	3,341.0	3,835.8	3,182.0	4,029.3	4,197.7	4,497.7	4,930.9	4,563.0	4,181.9	3,202.4	4,145.8	4,835.0
Offshore												
Australia	49.3	33.0	56.4	53.4	47.0	85.7	123.5	102.2	100.5	120.6	128.8	120.0
Bangladesh	9.5	3.9	16.3	6.4	12.2	43.1	47.6	18.1	16.7	23.1	49.9	
Belgium	226.7	54.7	-	-	-	-	-	-	-	12.7	36.4	
Brazil	68.7	278.6	114.7	129.0	240.3	274.4	367.8	491.8	238.1	128.9	214.6	254.0
Chile	16.0	9.5	11.8	12.4	-	20.3	13.5	20.3	15.6	19.6	31.3	
China	24.9	125.1	81.9	-	30.3	38.8	159.8	246.8	420.9	140.9	446.3	242.0
India	179.2	243.8	74.4	84.2	136.0	245.8	213.1	287.0	275.5	223.8	277.1	300.0
Indonesia	15.1	19.4	-	-	-	-	13.1	21.3	18.3	59.1	6.2	56.0
Japan	368.5	454.1	389.0	285.9	385.5	370.0	422.8	400.2	269.9	346.1	348.2	320.0
Korea	124.9	150.0	270.0	93.2	133.9	145.2	156.8	150.5	159.1	217.8	190.7	185.0
Malaysia	28.5	54.2	47.0	45.3	75.9	87.7	104.9	103.9	56.8	83.3	86.3	58.0
Mexico	-	-	-	-	-	12.8	12.7	49.8	25.3	12.8	-	
New Zealand	42.8	9.8	28.5	-	11.6	31.1	19.7	31.6	12.1	27.2	10.2	
Phillipines	22.7	10.9	23.7	24.6	30.4	30.0	39.5	45.9	39.5	39.9	42.4	
South Africa	2.8	5.1	9.3	18.2	21.5	41.8	16.6	30.2	33.2	12.7	22.4	
Taiwan	18.2	70.0	33.2	90.7	29.8	38.7	65.1	93.6	81.0	56.7	34.6	48.0
Total Offshore*	1,253.3	1,641.5	1,227.9	895.0	1,232.0	1,595.6	1,845.6	2,170.0	1,823.0	1,576.4	2,026.0	

* Includes countries not listed in the table.
** Sales figures for 1984 not available for all countries listed.

Source Energy, Mines and Resources Canada, Canadian Mines Yearbook.

somewhat counter to economic reasoning without further explanation. The explanation comes from the way in which Canpotex operates, contractual arrangements, and the changing nature of potash markets over the past five years. Canpotex ships surplus production from North America to offshore markets. During booms, there is very little surplus and hence, offshore prices can rise dramatically. When markets are weak, North American prices drift down and producers (including those in the United States) try to sell more of their potash production offshore. Offshore prices then decline. As well, other producers generally match any price reduction offered by PCS. But even with lower prices for the potash itself, Saskatchewan cannot greatly increase its share of offshore markets. This is because of the large share of transportation costs in the delivered prices.

Contract prices are generally valid for a period of up to six months. This is another reason for the divergence between North American and offshore prices. Given a stable environment, the two prices would be the same (adjusted for transportation costs). However, in cyclical economies, price divergences may occur temporarily due to different expiry dates on particular contracts. Thus, while in theory it seems that some price discrimination between offshore and North American markets could be possible due to differences in demand elasticities, in practice the opportunity to price differentially may be limited.

The income elasticity of demand was much more uniform across the different countries examined. The income elasticity for New Zealand, Japan, Korea, and Mexico was about .55. The specification of these demand curves also included a measure of arable land under cultivation. While the significance of the variable was low in many equations, for Japan and Mexico, I found a statistically significant land elasticity of -3.13 and -1.33 respectively. This means that land and potash are substitutes, strongly so in Japan where land use has become much more intensive over time. This is an important result. One would expect that over time, many of the developing nations will begin to use their agricultural land more intensively. In the past, many of these countries practised exhaustive agricultural techniques. Land would be farmed without any addition of fertilizer until its productive capacity was exhausted. It is doubtful that these practices can continue, simply because the supply of arable land is becoming quite scarce. If land is farmed more intensively, and if these land elasticities apply to other countries, demand for chemical fertilizers should be quite strong over time. A number of industry analysts estimate an average rate of growth of 2 per cent per year in potash demand. But, if my analysis is correct, these figures could be substantially higher for those developing countries adopting more intensive (and less exhaustive) agricultural techniques.

Potash markets have experienced two major cycles since Canadian production began. The first downturn occurred at the end of the

1960s just as all of Saskatchewan's new mines had or were about to come into production. Potash prices fell precipitously and Canadian producers had considerable excess capacity. The recovery began in late 1973 to early 1974. From then until the end of the decade, Saskatchewan producers experienced rising prices. Plans were in place for major expansions in production capacity by both PCS and some private-sector producers. However, by late 1981, the world recession, falling land and agricultural product prices, government programs in the U.S. that subsidized farmers to reduce acreage planted, and high interest rates as well as a recovery of export production in the U.S.S.R. had produced another major slump in world potash markets. Saskatchewan producers appear to have absorbed most of the cutbacks in consumption over this period, with 1982 and 1983 being disastrous years. Foreign suppliers made big inroads into the U.S. market by aggressive price cutting. Some U.S. producers sought trade restrictions on suppliers from outside North America. Potash markets recovered in 1984 and 1985, but prices are far from the levels obtained in the 1979-81 period. Some industry observers are optimistic about the future. There are no good substitutes for potash, although the fertilizer mix -- nitrogen, phosphates, and potassium can be varied somewhat depending on the crop and climate. Other analysts are less optimistic. They argue that a combination of excess productive capacity and prolonged weak demand in important markets such as the United States will keep potash prices relatively stable at their current levels well into the 1990s. A key factor is, for

example, U.S. agricultural policy. If the U.S. Congress eliminates price supports for agriculture, Saskatchewan potash sales will be seriously affected. As well, new producers in countries such as Jordan and Brazil may keep prices relatively low as they compete for a share of the market. Whatever the outcome, the government's strategies for PCS and its relationship with the private-sector producers will obviously have a bearing on its position in the world markets, as will be shown in Section 5.

3 FACTORS LEADING TO THE CREATION OF PCS

Throughout the past 15 years, the Saskatchewan provincial government has been very active in regulating the potash industry. The major objectives of the government appear to have been to attempt to achieve a stable production path over time and to obtain a share of the mineral rents from potash. Governments typically can use instruments such as taxation and quantity regulation to achieve these objectives. However, in Saskatchewan's case, a series of constitutional challenges to the traditional instruments, combined with an acrimonious relationship with the industry in the mid-1970s and a political philosophy of government participation in the private sector, led to the province's takeover of a substantial portion of the industry.

A variety of interesting economic issues are raised by government policies in the potash industry. These include the effects of the constitutional division of powers on the regulation of resource industries in a federal state, the role of public ownership, and the effects of oligopolistic market structures on the evolution of a resource industry. We will see how all of these issues are related in the Saskatchewan potash industry. I examine the way in which the provincial power to regulate the resources has come into conflict with the federal powers of taxation and and regulation of trade and commerce. These

constitutional conflicts turn out to be one of the major reasons why provincial ownership was chosen as the method of regulating the industry and obtaining a public share in the rents from potash in Saskatchewan. In this section, I examine the evolution of government policies which culminated in the formation of PCS in 1975.[5]

The first Saskatchewn potash mine was opened by International Minerals and Chemical Corporation (Canada) (IMCC) in 1962. Between then and 1970, nine more mines were opened in Saskatchewan. The primary policy objective of the provincial government over this period seemed to be to promote the development of the industry in Saskatchewan. The province's ten mines were operated by nine companies, of which two, Noranda (which owns Central Canada Potash) and Cominco, are Canadian. Five mines were controlled by various U.S. interests (IMCC, Potash Corporation of America, Kalium, Amax, Pennzoil, Texasgulf, Swift, and U.S. Borax). One was British and South African (Sylvite), and one was Franco-German with French government interests (Lanigan). To encourage firms to bring their mines on stream, the provincial government guaranteed a low provincial royalty payment (until 1981) if construction on a mine had begun by October 1967. This guarantee was provided in 1962 and it was promised to extend it to 1974 for all but two pioneers in the industry (IMCC and PCA), whose low royalty schedules were guaranteed until 1981. Further encouragement of speedy development was provided in 1964 by an

extension of the low royalty guarantee to all mines whose construction had begun before October 1, 1967.

This marked the end of what might be called the initial expansionary phase of Saskatchewan government policy. I should also note that these policies were brought in by the Thatcher government -- a government with an objective of encouraging private sector development in the province. The primary policy goal seems simply to have been to establish the industry in the province. As is not surprising, this policy resulted in a massive increase in potash capacity. With the downturn in the North American and world potash markets in the late 1960s, the large increases in world supply created by Saskatchewan contributed to the oversupply of potash in the late 1960s to early 1970s. Potash producers were operating with substantial excess capacity and generally were unable to cover production costs at the going transactions prices. The capacity of the Canadian industry had by this time given it the potential to have a major impact on market prices. The problem was to find a way to coordinate the independent oligopolistic behavior of the Saskatchewan producers.

Concurrently, New Mexican potash producers were putting pressure on the U.S. government to restrict Canadian potash imports. The New Mexican producers faced much higher operating costs than their Canadian counterparts and threatened to charge Canadian producers with dumping.[6] In 1969, the Thatcher government in Saskatchewan,

in consultation with New Mexico, agreed to a scheme to limit Saskatchewan exports to the United States. Under the Potash Conservation Regulation, all Canadian producers would be issued production licenses based on three factors: (1) forty per cent of the production capacity of each mine, (2) market demand for Saskatchewan potash, and (3) working stock and reserve requirements. A floor price of $33.75 per unit was also established. This scheme was called prorationing.

Both the Saskatchewan and American producers appear to have benefitted from the agreement, compared to the unregulated environment. The Saskatchewan producers benefitted by having the provincial government act as the coordinator and enforcer of cooperative behavior. The province still displayed little apparent interest in the size of the public revenues that would accrue from the industry. It is not clear whether it was the threat of trade restrictions from the U.S. or the desire to rescue the Saskatchewan industry from plummeting prices and profits that was more important in motivating the provincial government. However, both of these forces operated in the same general direction and their effect was to involve the government in enhancing the rents available to Saskatchewan producers. While measures that increased the price of potash to Canadian consumers entailed some efficiency cost on the consumption side, this was offset by the gains on the production side due to small sales of potash domestically. One difficulty, which would grow in importance

later, is that most of the mines were foreign owned. This meant that a large share of the producers' gains did not accrue to Canadians. Indeed, because all of the companies involved in potash production were large corporations, a very small share of any distributed profits would remain in Saskatchewan.

The first indication of possible conflict between the government and industry came in June 1972 when the government tightened the prorationing regulations and introduced a prorationing fee of 60 cents per short ton. The main effect of the new regulations was to effectively abrogate any existing long-term contracts. No mine could exceed its production quota, even to fill these contracts. The only company that this affected was Central Canada Potash (CCP), a Canadian firm, which had a long-term arrangement to sell amounts greater than its production quota to CF Industries of Chicago (which owned 49 per cent of CCP). To fulfill the contract, CCP was forced to buy from other producers. Aside from CCP, the rest of the producers did not appear to be unduly disturbed by the government's restrictions on output. The regulations did not differ substantially from those that might have been self-imposed through cooperative behaviour. The prorationing fee was another matter. The fee indicated that the government was becoming interested in its tax revenues from potash.

A complex series of legal and policy actions was set in motion in July 1972 when CCP challenged first its prorationing

allocation, then, in December, the constitutionality of provincial prorationing itself. In November 1973, the federal government joined CCP as a co-plaintiff in its challenge of prorationing. In the meantime, potash prices and hence profits began to recover. The provincial government raised the prorationing fee to $1.20 per short ton in October 1973. With the recovery of potash prices and profits, we now see the provincial government interested in its share of the rents, not just in stabilizing the industry. I should note that the NDP government of Allan Blakeney was elected in 1971.

In the face of the uncertain legal environment and the growing confrontation with the private sector firms, the Blakeney government began exploring alternative policy tools for accomplishing its goals of maximizing the economic rent from Saskatchewan potash and ensuring the distribution of a significant share of these rents to the provincial treasury. Several new policies were announced in 1974. The province wanted to alter the existing taxes on the industry and sought information about the potash producers' cost structure. The industry did not cooperate because it was uncertain about the government's true objectives and underlying agenda. A mutually distrustful and hostile environment developed between the government and industry. In 1974, the province announced a new tax on potash -- the Potash Reserves Tax (PRT), a tax designed without the benefit of a lot of key information about the industry. See Anderson (1981) for a

thorough analysis of the PRT and the events leading up to it. The tax was, in principle, designed to overcome the constitutional difficulties a provincial government faced in levying taxes on an industry which sells its products outside provincial boundaries.

Under the British North America Act, which was in effect until 1982, the federal government had jurisdiction over matters of interprovincial and international trade and had the exclusive right to levy indirect taxes. On the other hand, the provinces had the authority to raise revenues from and regulated resources lying within their boundaries and could levy direct taxes (as could the federal government). Neither government could levy taxes on the other level of government or its agencies. One of the major issues in the discussion of the division of economic powers in the new constitution centred on the conflict between provincial powers over resources and the federal tax, trade and commerce powers. Unfortunately, the new Constitution and the Courts have not resolved these difficult issues.[7]

The boom in primary commodities (including agriculture) of the 1970s produced massive regional differences in resource rents and in the fiscal positions of various provincial governments and the federal government. This resulted in tremendous political and constitutional conflict between the federal and provincial governments. It was in this atmosphere that Saskatchewan sought to increase its share of the rents it perceived as being extracted

(and exported) from Saskatchewan potash. The Potash Reserve Tax was the vehicle the provincial government hoped would accomplish its revenue objective without being declared unconstitional as it feared its prorationing fees and policy would be. The province hoped to argue that the PRT was a type of property tax and thus within its provincial jurisdiction. The industry saw the tax as a confiscatory profits tax, and, as will be seen below, launched another legal challenge.

Also in 1974, a policy was introduced which required government participation in new mines. For this latter purpose, the Potash Corporation of Saskatchewan was set up in 1975. These policies were consistent with the interventionist policy of the NDP government, but at that time, were not meant as a means of taking over a portion of the industry through acquisition of operating mines.

As potash markets recovered in 1974, the government removed both the production quotas and the price floor provisions contained in the Potash Conservation Regulations. Late in the year, adding further to the conflict over the sharing of the rents from the potash industry, the federal government announced that it would no longer allow mining companies to deduct provincial royalties as a cost in calculating taxable income. This federal move was part of a larger federal-provincial conflict over revenue sharing in all resource industries (particularly oil). The non-taxable status of

provincial crown corporations under the BNA Act suggested a way for the provinces to nullify the effects of this policy.

In 1975, court actions began restricting the province's ability to regulate the industry. In May 1975, the provincial prorationing policy was ruled ultra vires by the Saskatchewan Court of Queen's Bench. The component of prorationing that was found to be outside of Saskatchwan's powers was the price floor, because it interfered with interprovincial and, of course, international trade -- powers retained by the federal government. The quotas were not seen as outside the province's powers to manage and conserve the natural resources residing on crown land. The link between quotas and prices does not seem to have been recognized by the courts. In June 1975, the Potash Reserves Tax was challenged in court by all Saskatchewan potash companies (except CCP), and later was also declared ultra vires.

The province's ability to use traditional regulatory instruments was being seriously eroded. In particular, the power to regulate output through a system of quotas and the ability to regulate and raise revenues through taxation were becoming more constrained. The extremely hostile environment between the province and the private sector and the province and the federal government did not give the Blakeney government much confidence in being able to meet its objective of keeping potash rent in Saskatchewan. In light of this and the philosophy of government intervention of the NDP

government, as well as the fact that provincial governments and their agencies are not taxable by the federal government, the province's next move was quite predictable.

In November 1975, the newly reelected government announced in the Throne Speech its intention to acquire control over the potash industry through direct ownership. The announced target was to purchase about fifty per cent of the existing capacity. This, together with the undisputed (so far) power to control investment in new mining capacity would give the province direct access to rents generated in the potash industry as well as a "window on the industry" -- a direct means of obtaining information previously withheld from the government in its attempts to impose higher taxes. The provincial firm might also be able to use its market power to influence the behavior of the other firms and induce the Saskatchewan producers to behave in a cooperative manner to increase the aggregate rents from the province. The net benefits to the province would clearly depend on the relationship between the purchase price of the mines and the future rents generated from these mines, a topic I examine in Part 4. the fact that "fair market value" was to be determined inclusive of the effects of the PRT probably worked in the government's favour in this respect. In January 1976, the Potash Development Act was passed and in April the Potash Corporation of Saskatchewan Act was proclaimed.

As is not surprising, the private sector potash producers were distressed by the announced creation of PCS. The perception of many was that the socialist hordes would drive them out of business. However, nothing of the sort has occurred. Indeed, since the creation of PCS, the furor over potash has died down considerably. A number of factors are responsible. The provincial government did indeed begin buying potash mines. In October 1976, PCS purchased the Duval mine (renamed Cory division) at a price of $125.6 million. Two more mines were purchased in 1977. In April, the Sylvite mine (now Rocanville) was purchased for $144 million, and in October, the Alwinsal mine (now Lanigan) was purchased for $85.5 million. PCS then acquired interests in two other mines in 1978. The Esterhazy mine was obtained for $85 million in January (IMCC operates the mine under a long-term agreement with PCS). In April, a 60 per cent share of the Alcan mine was acquired for $85.5 million. The remaining 40 per cent is held by Texasgulf which itself was acquired by a federal crown corporation, the Canadian Development Corporation, in 1981. The total cost of these acquisitions was thus about $526 million.

The election of a Conservative government in 1982 has cast some doubt on the earlier plans of the province with respect to PCS. Under the NDP, a policy of capacity expansion of their mines was announced. At the same time, the government would not grant permission for private producers to expand. The incredibly

depressed markets of 1982 and 1983 put a halt to most of these plans. Under the Devine government, it is not yet clear what PCS will do. There has been some discussion of privatization and of allowing the private sector to do the expansions in capacity. The government has allowed Kalium to expand one of its mines, but will also complete the massive expansion of its own Lanigan mine. I will return to a discussion of PCS options in the last part of this paper. I now examine the performance of this government enterprise.

4 AN EVALUATION OF THE PERFORMANCE OF PCS

There are a number of ways of evaluating the performance of a private corporation. With a government enterprise, however, one must be careful to consider not only financial indicators of profitability, but also other objectives the government may have. For example, short term profits may be foregone in favour of long-run growth; employment may be stabilized at the expense of profits during downturns in demand. It may be that some private sector firms also pursue objectives distinct from profit maximization at each point in time. The problem is that we do not know exactly what managers of any firm, government or private, seek to maximize unless we are fortunate to have an explicit statement of objectives.

To evaluate the Potash Corporation of Saskatchewan, I will therefore make use of a variety of tools. First, I consider some standard financial indicators, i.e., ratios of profitability. Ideally, I would like to compare the indicators for PCS to those of the private producers of potash in Saskatchewan (and elsewhere). While I am able to do some comparisons, I cannot do a complete analysis because I am unable to get the mine-specific data for several firms operating in Saskatchewan. I therefore look as well at the performance of the mines PCS purchased individually, both before and after they were part of PCS. This

will give an indication of whether the government changed the operation of these mines dramatically. Because much of my information is proprietary, I can give general indications, but not specific numbers.

I consider not only financial indicators, but also other information that may suggest whether PCS is pursuing a strategy other than profit maximization. In particular, some observers have suggested that a government firm may seek to maximize or stabilize employment in the province. Is there any evidence that PCS is following an employment strategy different from that of private producers? The government may also be more concerned with social objectives, such as affirmative action programs in employment, or may have a greater concern for environmental preservation. A government firm may also view its policies from a longer-time horizon than the private sector. This could show up in, for example, implicit use of a lower social discount rate against which to evaluate its investment projects, more research and development into new processes and technologies that will benefit not only its own mines, but the private producers as well. There are, of course, other explanations for various types of government actions. Political influences are unavoidable.

I will not be able to untangle all aspects of PCS's performance since its creation, but hope to shed light on some of its activities, address the issues raised above, and answer the questions of

whether the investment made by the government was an economically rational one. That is, are the net benefits associated with the creation of PCS positive? After evaluating all the available data, my tentative answer is yes. In the sections to follow, I present the evidence and my evaluation. Part 5 of this paper then considers the behavior of the Saskatchewan potash industry more generally. I make use of my earlier work with Frank Flatters (1983) and examine possible forms of behaviour for a government firm. These are "tested" with data on actual behaviour (output and sales) of the Saskatchewan producers. The point of the exercise is to show what types of production strategies PCS could follow in theory, and to see if we can tell from the data which strategy PCS has been following. Finally, the theoretical model is used to examine the Saskatchewan industry over the long run. What combination of policy instruments that include PCS output, productive capacity, government taxes and regulations would maximize the rents from Saskatchewan potash production? We will see that coordinated actions among the producers could greatly increase the aggregate rents generated by potash extraction. I also consider possible foreign developments and competition to see what market power Saskatchewan producers are likely to have over time.

Financial Indicators of PCS's Performance

As noted above, there are a number of ways of evaluating the performance of a firm. I begin with some ratios indicating the

profitability of a firm. Table 3 presents a series of ratios for the period 1980-84 (the years for which I have data). The return on equity is the ratio of net income to equity. The return on investment is the ratio of net income to equity plus long-term debt, and the return on assets is the ratio of net income to average total assets. These figures are all taken from PCS Annual Reports, 1981-1984. The ratios give a rough idea of the return to investors in the firm. Because the investors in this case are the taxpayers of Saskatchewan, the ratios are in part a measure of the potential benefits from the creation of PCS. As the table indicates, there was a steady downward trend in all the ratios from 1980-1983, but a reversal in 1984. This is hardly surprising. As indicated in Section 2, the potash industry entered in late 1981 the worst downturn in demand since the late 1960s to early 1970s. Table 4 presents the average selling price realized by PCS from 1978 to 1984 both in nominal dollars and deflated by the Industry Selling Price Index (1971 = 100). As Table 4 indicates, potash prices peaked in 1981, then declined precipitously in 1982 and 1983. The realized price in 1984 was higher than in 1983, but it was still far from historical highs in both real and nominal terms.

Therefore, at least part of the explanation for the large decline in the ratios presented in Table 3 is the recession and fall in potash prices. But what about the 1980-81 period? Nominal potash prices rose, but the ratios fell. The explanation

Table 3

Profitability Ratios for PCS

	1980	1981	1982	1983	1984
			(Per cent)		
Return on Equity	26.1	19.4	.09	(3.0)	3.7
Return on Investment	22.4	17.3	.07	(1.8)	2.2
Return on Assets	19.5	14.7	.06	(1.6)	2.0

Source Potash Corporation of Saskatchewan, Annual Report, 1981-84.

Table 4

Potash Prices, 1978-84, $ per tonne K_2O

Year	Canadian Prices Realized by PCS Current $	Canadian Prices Realized by PCS Deflated $	U.S. Potash Prices Current $	U.S. Potash Prices Deflated $
1978	78.13	41.03	75.96	36.29
1979	104.33	47.88	95.20	40.41
1980	144.70	58.54	133.08	49.51
1981	159.43	58.53	137.20	46.76
1982	118.80	41.14	108.94	36.40
1983	97.85	32.76	99.92	32.97
1984	111.99	36.22		

Notes The deflator used for Canadian prices is the Industry Selling Price for all manufactured goods, Statistics Canada, 1971 = 100.

The deflator used for U.S. prices is the Producer Price Index for all commodities, 1967 = 100, U.S. Department of Commerce, Survey of Current Business.

The U.S. prices are an average of bulk potash prices for all grades.

Source Potash Corporation of Saskatchewan; U.S. Bureau of Mines, Mineral Yearbook, 1977, 1981, 1983.

is simply that production fell slightly (from 4.479 million tonnes KCl to 4.371 million tonnes), while selling, distribution and administrative costs rose. The recession was beginning to be felt by the third quarter of 1981. The increase in selling and associate costs is probably due in part to the expansion of distribution networks (unit trains and warehouses) in the United States. In 1981 PCS also announced that it was withdrawing from Canpotex (later rescinded when the Conservatives were elected). Part of these selling expenses must have been for the creation of the PCS International, the division that was to be responsible for offshore sales. These costs might be associated with increased profits in the future if PCS is able to move its product to buyers more efficiently than it has in the past. These selling and associated costs rose again in 1982 (but fell in 1983), when the full brunt of the recession was felt.

Two points can be made about the 1980-81 period. First, PCS apparently was basing its decisions on a continuation of strong sales for its products. This conjecture was incorrect. However, PCS did increase its share of total sales in this period over the previous two years due to its increased productive capacity.[9] Secondly, the decision to withdraw from Canpotex was seen as a policy which would increase sales in the long term. PCS had been critical of the method by which contracts were negotiated through Canpotex. Each of the seven members (PCS plus six private sector producers) has only one vote. Although PCS had over 40 per cent

of the productive capacity, it had only a one-seventh say in all matters. Being the "new kid in town" also led to a feeling of impotence in the decision making. Yet another factor was that, as a government enterprise, PCS may have been able to negotiate with the governments buying potash more favourably than a consortium of largely private producers.

The very small values for 1982 and losses for 1983 are due primarily to the recession and low prices of potash. However, there is another factor. Long term debt increased substantially in 1982, rising from slightly over $88 million in 1981 to over $221 million in 1982. Unfortunately the debt was at relatively high interest rates (compared to previously acquired debt) of 15 and 16 per cent for two bearer bonds maturing in 1992 and 1989 respectively. The debt was incurred to finance the expansions at Lanigan and Rocanville. The expansion schedule at Lanigan was deferred during the severe downturn (but has since proceeded). Again, one could say that the Corporation did not adequately forecast the economic downturn. On the other hand, with its expansions now in place, PCS could be ready to pick up market share as demand increases. It is difficult to assess performance during a downturn when investments in new capacity have been committed. While it is true that short-term profits suffer, long-term profits may be enhanced.

Another way to view these profit figures is to compare them with what was happening to private sector producers. As noted above, I do not have enough data on the private producers to do a comprehensive comparison. However, I am able to compare profit margins (the ratio of net income to gross revenue) of PCS with those of three private producers. Table 5 presents the results. Going back to 1979, the first full year of operation for all PCS mines,[10] the top half of Table 5 shows the profit margin of PCS and an average profit margin for three private producers. Compared to the private producers, PCS did quite well for the period 1979-1982. Indeed, even if we look at the entire period including the recession, the average profit margin for PCS is 19.2 per cent, while that for the private producers is 11.4 per cent. The difference between the two sectors is how each fared in the recession. From the figures, the private producers appear to have taken their losses in 1982 and were coming out of the depressed times by 1983. As noted above, PCS had its worst year in 1983. In the bottom half of Table 5, production for PCS and all private sector potash producers is shown, as well as PCS's share of total production and the per cent change year to year. From the table, it can be seen that PCS did make greater output reductions in the period 1981-83 than the private producers. From 1981 to 1982, PCS cut production by about 34 per cent, while the three private-sector producers reduced production by around 23 per cent. From 1982 to 1983, both PCS and the private firms increased output. But the increase in PCS output was about 8 per cent,

Table 5

Profit Margins and Potash Production

	1979	1980	1981	1982	1983	1984
Profit Margin (per cent)						
PCS (net 4/total revenue)	28.3	42.7	36.9	0.32	(8.3)	9.1
Private Producers*	18.5	20.8	17.8	(8.4)	7.2	12.7
Production (000 tonnes KCI)						
PCS	3,976	4,479	4,371	2,866	3,106	4,502
Private Producers**	6,032	7,489	7,391	5,672	6,613	8,201
Total Production	10,008	11,968	11,762	8,538	9,719	12,703
PCS Share of Total (Per cent)	40	37	37	34	32	35

* Average profit margin for three private producers of potash.

** All private sector potash producers.

Source Potash Corporation of Saskatchewan, Annual Report 1983, 1984 for PCS data.

while that of the private producers was over 16 per cent. Thus, PCS took deeper cuts in production and increased output more slowly than the three private firms represented here. PCS may have been trying to maintain potash prices in the downturn by absorbing the shortfalls in demand (see Section 5). But by 1983, PCS had apparently decided not to continue this strategy. Potash prices continued to fall from 1982 to 1983, but with its small increase in output, PCS sales revenue increased slightly over its 1982 level. However, the increased revenue was not enough to offset its higher operating costs and interest expenses (due to increased capital expenditures and higher interest rates). Without examining income statements for all the private producers, it is impossible to tell precisely why PCS's experience is different from the private producers. It could be explained by differences in long-term debt and a different strategy.

I should point out an important caveat for Table 5. The profit margin for the three private producers excludes, of course, the profits for the other private sector firms. If the three firms for which I have data are significantly different from the omitted firms, the comparison will be biased. I do not know which way the bias, if any, works. In other words, I do not know if the firms I have presented are on average more or less profitable than the firms I have omitted due to lack of data.

In all of the indicators above, net income is calculated by subtracting all operating cost, depreciation and amortization, selling expenses, interest payments and taxes. As noted in Part 3, PCS does not pay any federal taxes. This may be one reason for its favourable profit margin for the periods where all mines are earning profits. PCS simply had higher profits because it did not pay the federal taxes. When companies were forced into a loss or very low profit situation, the federal taxes paid by the private producers would be negligible or zero. Thus we would expect the difference between PCS and the private producers to be smaller in a recession than in a boom. Again, without knowing the taxes paid by the private producers, I cannot fully test this conjecture.

Taxes are important in another respect. PCS does pay all provincial taxes. As noted above, these taxes are deducted from revenues in calculating net income for PCS as well as in any private-sector firm. Thus government ownership of PCS does not change the total tax revenue collected through the PRPAs. Even if PCS were a private firm, it would still pay the same provincial tax. However, it could well be the case that the presence of PCS has changed the actual form (or rate) of the provincial potash tax. Without PCS, the PRPSs may have been quite different. I cannot discern just what the tax settlement would have been without PCS. The presence of PCs undoubtedly put the government

in a different bargaining position than it would have encountered without PCS.

Table 6 presents a very crude estimate of the "rents" from PCS. In this table, rents are defined as the sum of provincial tax revenue plus net income. Both nominal and deflated values of rents are calculated. As shown in Table 6 are the retained earnings of PCS and its dividend payout. Beginning in 1980, PCS paid a dividend to the Province's Crown Investments Corporation. Note that this dividend was paid (and increased) during PCS's worst year, 1983, but reduced significantly in 1984. When rents are divided by gross revenue, the "rent margin" for PCS looks even more favourable.

Finally, let us examine the question of whether or not the purchase of private sector mines was a good investment for the people of Saskatchewan. Table 7 presents my calculations of the return on the initial investment of $525.6 million in the five mines PCS acquired. PCS has of course invested more in its mines since they were purchased. These additional expenditures are examined in Table 8. The calculations are based on Table 6 and show the return on investment based on net income and rent. The returns are also presented in nominal and deflated dollars. For the period 1978-81, PCS looks like a very good investment. It is hard to imagine an investment that would have yielded an after-tax return to the residents of Saskatchewan of 21, 34 and 26 per cent,

Table 6

Rent from PCS

	1977	1978	1979	1980	1981	1982	1983	1984
Tax Revenue from PCS (000)	16,280	35,100	58,280	89,540	70,770	15,020	12,610	17,692
Net Income (000)	1,120	24,720	77,964	167,449	141,721	607	(18,007)	25,349
Nominal Rent (1+2) (000)	17,400	59,820	136,244	256,989	212,491	15,627	(5,397)	43,041
Rent in Constant $*	17,400	54,780	108,995	181,233	135,951	9,431	(3,149)	24,262
Rent Margin (nominal rent/revenue) (Per cent)	-	-	49.6	62.9	54.2	8.1	(2.5)	15.5
Rent Margin (real rent/revenue) (Per cent)	-	-	39.6	44.3	34.7	4.9	(1.4)	8.7
Dividend (000)	-	-	-	50,000	50,000	50,000	62,000	12,000
Retained Earnings including tax revenue (end of year) (000)				311,338	384,289	279,146	196,729	215,160
Retained Earnings net of tax (end of year) (000)				221,798	313,519	264,126	184,119	197,468

* Nominal rent is deflated by the Canadian Industry Selling Price Index for total manufactured goods, 1971 = 100 to yield rent in constant dollars (real rent).

Source Potash Corporation of Saskatchewan, Annual Report 1981-84. Statistics Canada, Price Indices.

Table 7

Return on Investment of $525.6 million in PCS

	1978	1979	1980	1981	1982	1983	1984
				(Per cent)			
Net Income*							
Nominal	4.7	14.8	31.9	27.0	0.10	(3.4)	4.8
Constant $	4.3	11.9	22.5	17.3	0.06	(2.0)	2.7
Rent*							
Nominal	11.4	25.9	48.9	40.4	3.00	(1.0)	8.2
Constant $	10.4	20.7	34.5	25.9	1.80	(0.5)	4.6

* Net income and rent in both nominal and constant dollars are defined by Table 6.

Source Table 6, Potash Corporation of Saskatchewan, Annual Report 1981-84; Statistics Canada, Price Indices.

Table 8

Return on Initial Investment in PCS Plus Subsequent Capital Expenditures

	1979	1980	1981	1982	1983	1984
			(Per cent)			
Net Income						
Before Depreciation	13.9	25.5	16.6	0.06	(1.6)	2.1
After Depreciation	13.9	26.6	17.8	0.06	(1.7)	2.3
Rent						
Before Depreciation	24.3	39.1	24.9	1.60	(0.5)	3.8
After Depreciation	24.3	40.8	26.8	1.60	(0.5)	3.8
			($ millions)			
Total Value of Capital						
Before Depreciation	560.2	657.2	852.0	992.5	1,101.2	1,215.1
After Depreciation	560.2	629.6	793.9	970.2	1,044.8	1,120.9

Note Net income and rent are from Table 6, current dollars.

Source Potash Corporation of Saskatchewan, Annual Report 1983, 1984.

adjusted for inflation. For the period 1982-83, Saskatchewan residents would have been better off with their money in a savings account. 1984 shows a modest return on investment. Over the entire period, PCS looks on average to have been an excellent investment.

Table 8 presents only the nominal values for the adjusted capital stock (initial investment plus additional capital expenditures) for the period 1979-84. The rate of return is shown both before and after the depreciation shown in each year's Annual Report. As is not surprising, the returns are reduced somewhat, but not substantially. It still appears that PCS was a good investment. One should also remember that these tables show simply PCS's rate of return, not those of other private-sector producers. In the recession, all would show a decline in their return on investments. Without data for the private producers, I cannot say whether PCS did relatively better or worse.

Tables 7 and 8 presented the return on investment. To complete the financial analysis, I examine the present value of the initial investments in each PCS mine over the period 1977 to 1984. Is the present value of the investment greater than zero? I do the calculations at discount rates of 5 and 10 per cent, the former more representative of a social discount rate, the latter of a private discount rate. At 5 per cent, the present value of $535.6 million is about negative $20 million by the end of 1984.

At a 10 per cent rate, the present value is negative $75 million. These present values are calculated using the figure for potash rent, not net income. If 1985 is a reasonably good year with, says, rents of $50 million, the present value could exceed zero this year at a 5 per cent discount rate. At a 10 per cent discount rate, it may take until 1987 or 1988 to see a positive present value.

What do these calculations mean? At a discount rate of 5 per cent, the initial PCS investment will probably generate a positive present value after 8 years. At 10 per cent, it will take more than 10 years to do so. The life of the potash assets is well beyond 10 years. Although some of the mine and mill capital has depreciated, these assets should have a productive life of at least 20 years (using Sheldrick's 5 per cent depreciation estimate). Each PCS mine would have to be fully examined separately to see when the mine and mill assets will be fully depreciated. None of the mines will hit the 20-year point until 1988 at the earliest. Thus it appears that even with the poor performances in 1982 and 1983, the present value of the initial investment in PCS mines will be positive. In addition, the demonstrated reserves of potash in these mines range from a low of 219 million tonnes of ore (about 57 million tonnes K_2O) to 653 million tonnes of ore (141 million tonnes K_2O). Capacity at any PCS mine is currently less than 1.5 million tonnes K_2O per year, and production has been below capacity. It will therefore take quite a few years to

deplete these mines. The investment again appears to be reasonable, based on economic criteria.

Finally, using my average cost regressions for four PCS mines, I look at the relationship between production at each mine and the real average costs of operating the mine and mill at each output level. The results are shown in Table 9. The average costs shown are derived from the equations estimated for each mine (available upon request), using the actual output figures for that year. All costs are in 1971 Canadian dollars. It is important to note that these are not the actual deflated average costs. There are some difficulties with the average operating cost equations. Some mines, notably Lanigan, have increased productive capacity over the period. I did not have enough data to estimate separate cost functions for each different capacity level. It is anticipated that the average costs for Lanigan will shift down significantly when the new capacity is utilized. The average cost functions were estimated for the mines over the period 1971-83. Thus, the data includes operations of PCS mines when they were owned privately. Data for the years in which PCS took control are often not representative of a normal operating year.

The functions are based on aggregate potash output from each mine, assuming the product is homogeneous. In fact, each mine produces a particular mix of potash grades and products. PCS then allocates production among its mines, not simply on the basis of

Table 9

Output* and Predicted Real Average Costs for PCS Mines**

	1979	1980	1981	1982	1983	1984
Allan						
Output	396	359	439	287	224	341
Average Costs	23.50	24.40	22.60	26.20	27.80	25.06
Cory						
Output	553	589	547	325	359	446
Average Costs	11.60	10.60	11.70	19.50	18.05	14.77
Rocanville						
Output	601	666	595	493	532	815
Average Costs	11.40	10.40	11.50	13.20	12.52	8.43
Lanigan						
Output	351	490	499	185	317	520
Average Costs	28.34	22.63	22.28	33.10	29.71	21.47

* Output is in thousands of tonnes K_2O.

** Real average cost is calculated from regressions of average operating costs before tax, deflated by the Canadian Industry Selling Price Index for Total Manufactured Goods, 1971 = 100, on output.

Source Potash Corporation of Saskatchewan, Annual Report 1983, 1984 for output figures.

average aggregate cost, but based on product mix as well. Mines which may have higher average costs may not reduce production in a downturn if they produce a product that has a buyer. Finally, production is also allocated on the basis of relative transportation costs. The PCS mines located in the southern part of the province ship primarily to the United States because of low freight rates. Those in the north tend to ship to offshore markets (through Vancouver). Therefore in any given year, a higher cost mine may be producing more than a lower cost mine because of a combination of these factors.

Therefore it is difficult, given my data, to address the question of whether or not PCS allocated production efficiently among the mines it operates. Because my cost curves are U-shaped, this suggests that all mines should be operated in the range of minimum average cost. Looking at Table 9, this does not appear to be the case. I have already noted some explanations for these observations. It is also very costly to close down mines. Thus in the downturn, some production had to be maintained at all the mines. It appears that, for 1979-81, PCS organized output to achieve a relatively constant average cost for each mine. In 1982-83, average costs rose due to the reduction in output at all mines.

The average cost curves estimated intersect. Thus at high output levels, costs are minimized by operating a particular set

of mines more intensively. When aggregated output is low, another set should be operated relatively more intensively. The "output mix" among the PCS mines is thus complex, and the assessment of cost efficiency requires further analysis.

In summary, PCS did very well financially from its creation until 1982. It has added large sums to provincial revenues, well beyond what the mines PCS purchased would have generated through provincial taxes if they had remained in the provincial sector (compare taxes to net income in Table 6). However, 1982 and 1983 were not good years for the Potash Corporation. As the discussion above shows, they were not good years for any potash producer in Canada. The question remains, however, whether PCS will recover. The company is optimistic. When it released its 1984 Annual Report in April, the president felt the corner had been turned and that the company, having returned to profitability in 1984, would continue to improve in 1985. There are, of course, a number of uncertainties that can affect the future performance of PCS. I examine these in Section 5. I turn now to a brief discussion of some objectives PCS could be following other than profit maximization.

Other Aspects of the Performance of PCS

As discussed in the introduction, a government enterprise may have objectives other than profit maximization. These include

social and environmental objectives, and long-run development and diversification of the provincial economy. It is more difficult to assess this area, but given some evidence from PCS reports, these areas can be covered at least in part. Let us first look at employment.

Is there any evidence that PCS had different objectives with regard to employment than did its private sector counterparts? There is some evidence that there are differences. Statements by PCS suggest that it is following a broader set of employment objectives than its private-sector counterparts. PCS has been a leader in creating good labour regulations and a stable workforce. For example, when Lanigan was closed down in 1979 for revamping, most of the workforce was maintained. When the downturn in potash markets began, PCS was ready to ride it out without laying off workers. It was when the Corporation saw that the slump was going to be prolonged that workers were laid off.

To look in more detail at employment, I can compare PCS to the three private sector producers for which I have data. Using data for four PCS mines and three private-sector mines on employment and output, the average product of labour over the period can be computed. What do we find? First, there is a lot of variation in employment over the period, as one would expect over a business cycle. Secondly, a number of the mines have increased their capacity since initial construction. This presumably increases

employment. In addition, there has certainly been technological change over the period. I do not know if it has been labour-saving or not, but, given the high degree of capital intensity in the potash industry, my guess is that innovations have been labour-saving. Therefore, I look not just at employment, but at the average product of labour to get an idea of whether the PCS mines have been different from private firms and whether the PCS mines themselves exhibit significant changes from the period when they were under control of private producers to the period under PCS.

My interpretation of the numbers is as follows. All mines increased employment over the boom period, 1979-81. PCS mines had an average increase of 15.5 per cent over the period, while the private producers averaged a 14.7 per cent increase. There is little difference there. During the recession, PCS reduced its labour force by an average of 13.25 per cent from 1981 to 1982, while the three private sector producers reduced employment an average of 12.7 per cent over the same period. Again, the performance is very similar.

If we look at the average product of labour, the signals are more mixed. The question here is whether there was a significant change in the performance of PCS mines when they switched from private to government control. For two of the PCS mines, there is no change in the average product of labour over the pre-PCS period from 1971 to 1977 and the PCS period from 1978 to 1984. For the

other two PCS mines, the average product of labour declines by an average of 14.8 per cent in one mine and 19.8 per cent in the other between the pre-PCS and post-PCS years. For the mines in question, there may be an explanation. Both mines for which the average product fell had increases in capacity. This may be affecting the computation. There may have been technical difficulties at these mines as well that affected productivity. But a decline in the average product may indicate a preference for maintaining employment at stable levels, even when it is not productive. Average products were generally the lowest during the recession periods. This suggests that although PCS cut employment and output during these periods for two of its mines, it did not reduce employment enough to prevent a decline in productivity. Some other objective may have been at work. One additional factor may be that PCS has recently switched from four to three shifts per day. This is expected to increase productivity, but the effects have not yet shown up in my data.

How did the private producers fare? To compare PCS with these producers, I again break the period up into 1971-77 and 1978-83. Of the three producers, one had a small decrease in its average product of labour (about 4 per cent) between the two periods. The other two firms had significant increases in their average products over the two periods (11 and 41 per cent). This suggests that the private sector was able to maintain labour's productivity at a higher level over the business cycle than did the PCS mines.

I cannot determine why this is the case, but simply note the differences and suggest that PCS has been following an employment strategy different from that followed in the private sector.[11] But if we look at the average product of all PCS mines taken together over the period 1978-1983 and compare that to the average product of labour for the private producers taken together over the same period, we find the average product of PCS's four mines to be 1.27 and that of the private producers 1.36. Eliminating the mine in PCS with the poorest average product increases PCS's average to 1.41. What this suggests is that some more complex strategy among PCS mines could be at work.

In the areas of environmental policy and health and safety issues, let me simply note that PCS appears to have been quite conscientious in its attempts to minimize pollution and ensure a safe environment for its workers. The evidence I have on this subject comes from the annual reports of PCS and some articles in various newspapers and mining periodicals. PCS has spent money upgrading and installing pollution control equipment, and plans to continue programs to minimize various sorts of emissions. The Corporation announces in its annual reports the accident-free period at its mines. In 1983, its Rocanville division reported no compensable injury among its 404 employees, while the Allan division won the Provincial Mine's Rescue Competition. These are by no means a comprehensive list of achievements. They suggest some degree of concern for employees' safety. The 1983 Annual

Report also notes that PCS is developing a long-range affirmative action program for its head office and subsidiaries. It is of course too early to tell what this means in practice.

PCS has a policy of spending at least one and a half per cent of sales revenue on research and development. Since its formation, PCS has spent more on R&D than any one of its Saskatchewan competitors, with IMC in second place. PCS has a research and development group of 26 engineers and technicians, and is evaluating new mining techniques and attempting to develop new products. A prototype mining machine (the Orebiter) has already been developed and is being tested in its Lanigan mine. The Orebiter has received favourable attention in mining periodicals (see Barry, 1983 and Kaukinen, 1984). I cannot directly compare these R&D activities to what would have happened in the mines PCS acquired had they remained under private ownership. PCS's activities are done in the province, while it may be the case that some of the private firms may have located their R&D with their head offices which are outside of Saskatchewan. The Corporation views its R&D output as proprietary and essential to sustain long-run profitability. It may engage in joint projects with other companies, especially in areas of social gain such as environmental protection and workplace health and safety. It is too early to evaluate the long-run benefits of these R&D expenditures, but the company is optimistic about the development of new products and techniques which will enhance its competitive position.

Does PCS invest in products different from those of its private sector counterparts? As mentioned before, PCS did engage in a program in the late 1970s until the early 1980s to increase its productive capacity. In Section 5, I will examine this capacity expansion decision from the viewpoint of corporate strategy. Now the question is whether the company is basing these decisions on some sort of social rate of return that is different from the rate used by the private producers. According to the Corporation, generally accepted industry practices are used to evaluate any new investment project. That means that higher rates of return are required for new developments (new mines) and lower rates for expansions of existing mines. Although PCS may be taking a longer view with regard to R&D expenditures than its private sector counterparts, it does not appear to be basing investment projects on a different discount rate than the private sector.

Is there any evidence that the provincial government is using the rents from PCS to diversify and/or expand its economy? One would have to say yes. Since 1980, PCS has paid a dividend to the province's investment corporation. I cannot examine the explicit use of these funds. However, it would seem reasonable to assume that these funds were not being reinvested in potash, but in some other activities. Some observers have criticized the province for extracting dividends from PCS, especially during their unprofitable year. It is too early to tell if these diversions to other

activities has generated a return greater than would be obtained from potash.

So far, I have had little to say about political factors. This is not to suggest that they are unimportant, but simply that my emphasis has been on an economic evaluation, not a political one. There are some papers which treat political factors much more extensively. See, for example, Pratt and Richards (1979), Richards (1982), Laux and Molot (1984), Doern and Prince (1985), and their references. I will address one issue in the next section -- privatization. When the Progressive Conservatives came to power in 1982, there was a lot of talk about privatizing some (or all) of Saskatchewan's crown corporations. To date, no explicit decisions have been made with respect to PCS. I will return to this below when I examine potential strategies for PCS.

In summary, PCS looks like it has generated fairly substantial rents to the province of Saskatchewan. While 1982 and 1983 were poor years, the period from 1978 to 1981 was extremely profitable, and 1984 has seen PCS return to a profitable year, albeit modest. PCS is pursuing an expanded set of objectives which include long-term growth through R&D and increased capacity, concern for stable employment, the environment, and improved health and safety. These concerns have not driven the Corporation into an unprofitable situation. The residents of Saskatchewan may thus have benefited considerably from this company, which has generated rents without compromising social concerns.

5 MARKET STRATEGIES FOR PCS

Two issues are addressed in this section. I first examine the possible equilibria that could be obtained under different types of oligopolistic behaviour of PCS. The objective is to see what incentives PCS has, if any, to deviate from the behaviour that would characterize a private-sector firm operating in the potash industry. It is not obvious how a government-managed firm will behave in an oligopolistic industry. Do we expect to see a different objective function for PCS than for a private-sector firm with the same capacity, reserves, cost and demand conditions? What are the gains to PCS and Saskatchewan from pursuing different strategies? To answer these questions, a simple model of the potash industry is constructed. The model will contrast an oligopoly equilibrium before the formation of PCS with the possible equilibria that could result after the creation of PCS. Initially, an equilibrium concept is not imposed a priori on the industry. Rather, alternative equilibria are examined in an attempt to discover which one (or ones) are most compatible with PCS's powers, constraints, and possible objectives. The model is then "tested" against the data for the pre- and post-PCS period.

The focus is on the North American market. As noted before, all "offshore" sales (outside of North America) of Saskatchewan potash are made through the seller's organization Canpotex. Each

producer gets one vote in determining Canpotex sales and offshore potash prices. The model presented in this section will not be directly applicable to offshore sales.

The second consideration in this section is the longer term prospects for the province's potash industry. In particular, what mix of taxes, PCS output and pricing, and investment in new potash capacity would maximize the rents from potash extraction in Saskatchewan? To examine these issues, I must also consider Saskatchewan's relationship to other potash producers outside the province.

The "stylized facts" for the potash industry that are incorporated into the model are the following. Firms are assumed to choose output levels, not prices. While there is some evidence of price leadership in the North American market, it is sketchy. Anderson (1984) suggests that there is some barometric price leadership -- one firm announces a price and the others follow. But there is also evidence of substantial deviation from the posted price throughout the fertilizer season and among different firms. Given that production decisions must be taken before the transaction prices are determined, quantity setting behaviour seems appropriate.

Potash is treated as a homogeneous good. There are differences in ore grades among the producers, and different products (grades

of potash) can be produced, but I ignore these differences because they will not affect the basic results of the model. All potash sales can be expressed in K_2O units. Measured reserves of potash in Saskatchewan account for some 74 per cent of the world's potash reserves in 1983. Output from Saskatchewan mines constituted almost 27 per cent of world potash production in 1980 and 40 per cent of the world's export market. In the United States, Saskatchewan producers have consistently supplied over 70 per cent of total potash consumed. Thus it is reasonable to argue that Saskatchewan producers could assert some market power. They cannot act like a pure monopolist, as other producers will constrain their behaviour. In the model that follows, the other producers are assumed to be oligopolistic competitors, not a competitive fringe.

Given these "facts", a model has been developed to examine some possible equilibria in the North American market under different behavioural assumptions for PCS and its competitors. The model is static. Static models can only deal with particular issues, namely the determination of output, given capacity. But static models are much more tractable than dynamic ones, especially under certain equilibrium concepts.[12] Also, given the huge size of Saskatchewan's reserves, the shadow price of ore in the ground is effectively zero, so a dynamic resource model is not necessarily going to add much to the analysis.

It is assumed that the North American potash industry is an oligopoly in which each "firm" produces a homogeneous product and faces a downward sloping linear demand curve which is dependent on aggregate industry output. Demand is assumed to be inelastic, as was discussed in Section 2. Three "firms" are assumed to constitute the industry. Each represents an empirically relevant type of producer and reflects the different production costs in the industry. Firm G is PCS, S represents the private-sector Saskatchewan producers (hereafter called S producers), and R, the rest-of-the-world (ROW) producers which supply the U.S. market. PCS and S producers are assumed to have identical average production costs which are assumed to be constant (and later normalized to zero). ROW producers have higher constant extraction costs than G and S.

The exercise taken is to solve for five different oligopoly equilibria. These are: (1) the Nash-Cournot (non-cooperative) equilibrium; (2) the Stackelberg equilibrium, where PCS is the Stackelberg leader; (3) a joint-profit Stackelberg equilibrium in which PCS maximizes the profits of the S producers as well as its own; (4) a Stackelberg equilibrium where G and S collude; and (5) a Nash equilibrium where G and S collude. In each case, output, prices, profits, and market shares of each firm are determined. The theoretical results are then contrasted with actual industry behaviour, using, first, arbitrary values for the key parameters, then some more realistic estimates of these

parameters. The non-cooperative and joint-profit equilibria are then examined in detail with the inclusion of another policy variable for the government -- mineral taxes.

The Nash Equilibrium

The Nash or non-cooperative equilibrium is assumed to be the base case. That is, before the formation of PCS, the potash industry is assumed to be a noncollusive oligopoly where all firms choose their output based on conjectures about the output of other firms. Each firm then maximizes its profits by choosing a level of output, q_i for i = G, S, and R, which depends on its costs and the (inverse) market demand curve D(P) which is given by

$$P = a - bQ \qquad \text{where } Q = \sum_i q_i \tag{1}$$

Each firm has zero fixed costs and constant average and marginal costs of extraction, c_i. The non-cooperative equilibrium for the oligopoly is then derived from the simultaneous solution of the three firms' reaction functions, where the reaction functions are obtained in the usual way from each firm's first order conditions for a profit maximum. Let Q_{-i} equal $\sum_{j \neq i} q_j$, then profit maximization requires $MR_i = MC_i$ for each firm i, where

$$MR_i = a - 2bq_i - bQ_{-i}$$
$$MC = c_i \qquad (2)$$

Equating MR_i and MC_i and solving for q_i, we obtain the ith firm's reaction function

$$q_i = (a-c_i)/2b - (1/2)(Q_{-i}) \qquad (3)$$

For i = G, S, and R, the Nash equilibrium must then have q_G, q_S, and q_R chosen simultaneously such that equations (4) are satisfied.

$$\begin{aligned} q_G + \tfrac{1}{2} q_S + \tfrac{1}{2} q_R &= (a-c_G)/2b \\ \tfrac{1}{2} q_G + q_S + \tfrac{1}{2} q_R &= (a-c_S)/2b \\ \tfrac{1}{2} q_G + \tfrac{1}{2} q_S + q_R &= (a-c_R)/2b \end{aligned} \qquad (4)$$

Given the assumption that $c_G = c_S$, the solution of (4) is simplified. Let $c_G = c_S = c_L$ (for low-cost producer). It is then clear that q_G must equal q_S and the three reaction functions can be collapsed into two and solved for the output from either PCS or S, which is denoted q_L, and ROW output. In a Nash equilibrium, then,

$$q_L = (a + c_R - 2c_L)/4b$$
$$q_R = (a - 3c_R + 2c_L)/4b \qquad (5)$$

Without loss of generality and for analytical ease in comparing the Nash equilibrium to the other equilibria, let $c_L = \emptyset$, $a = 24$, $b = .5$, and $c_R = 4$. The Nash solution is then $q_G = q_S = 14$ and $q_R = 6$. Industry output is 34. The equilibrium price is 7. Table 10 lists these results (and those of subsequent equilibria) for these parameter values.

Stackelberg Equilibrium

Suppose now that PCS can act as a Stackelberg leader because it controls a large percentage of North American sales and capacity. PCS maximizes its own profits independently of other producers by announcing its output first, while the other firms take q_G as given. The Stackelberg equilibrium then consists of PCS's profit-maximizing output and the other firms' equilibrium functions which depend on q_G. Now in this and all subsequent cases let $c_L = 0$ and $b = \frac{1}{2}$. The equilibrium reaction functions are then:

$$q_S = (2/3)(a+c) - (1/3)q_G$$

$$q_R = (2/3)a - (4/3)c - (1/3)q_G \qquad (7)$$

Table 10

Oligopolistic Equilibria

Variables	Nash, Stackelberg Joint-Profit (γ=1) and Stackelberg Cartel	Stackelberg	Stackelberg Joint-Profit γ = .5	Nash Cartel
q_G	14	28	22.4	9.33
q_S	14	9.33	11.2	9.33
q_R	6	1.33	3.2	10.67
Q	34	38.70	36.8	29.33
P	7	4.67	5.6	9.33
π_G	98	131	125.4	87
π_S	98	44	62.7	87
q_G/Q	.41	.72	.61	.31
q_S/Q	.41	.24	.30	.31

Parameter values for table:

$a = 24$
$b = .5$
$c_L = 0$
$c_R = 4$

PCS then maximizes its profits, π_G, given the demand curve which is dependent on its output and the equations in (7). Making the substitutions and simplifying,

$$\pi_G = (1/3)\ (a+c)q_G - (1/6)q^2_G \qquad (8)$$

Differentiating (8) with respect to q_G, and solving for q_G yields the Stackelberg output for PCS equal to (a+c). The output for S is then (1/3)(a+C) and for R it is (1/3)a - (5/3)c. Using the same parameter values as above, we find that Q = 38.7 and P = 4.67. PCS thus doubles its output and its profits rise. The output and market shares of the other firms decline, but total industry output rises and the market price falls, thus decreasing S and R's profits. Of course the Stackelberg results are crucially dependent upon other firms accepting PCS as a leader.

Joint-Profit Equilibrium

If PCS were a private-sector firm with the same potential market power, then we might expect it to attempt to pursue a Stackelberg-type strategy. The payoff is clear. PCS would have a very large share of the market and high profits relative to the other firms. But as a Crown corporation, PCS is presumably interested not just in its own profits, but in the return to the government from the entire potash industry in Saskatchewan. If all private sector

firms were owned by Saskatchewan residents, the government might simply have as its objective function the maximization of total Saskatchewan profits regardless of which company earns them. But as noted in Section 2, Saskatchewan residents own a negligible share of the private-sector companies. Thus the share of profits accruing to Saskatchewan residents from the private companies is simply the tax revenue received from provincial mining plus income taxes. There are, of course, other benefits to Saskatchewan residents from the operation of the private companies -- direct and indirect employment effects, but these are relatively small due to the high capital intensity of the industry (see Anderson, 1984).

To capture the interdependence between PCS and S producers, the government's objective function is now altered. Suppose now that G maximizes π, where π is $\pi_G + \gamma\pi_S$. γ is the weight PCS attaches to the profits of the private sector and can be interpreted as the effective tax rate on the private sector. PCS continues to pursue a Stackelberg strategy.

Profits of PCS are now given by

$$\hat{\pi} = (q_G + \gamma q_S)(a - bQ) \qquad (9)$$

Suppose first of all that $\gamma = 1$ (meaning complete joint-profit maximization or a tax rate equal to 100 per cent). Then making

the usual substitutions, differentiating with respect to q_G and solving for q_G, we find that PCS output is (1/2)(a+c). The output and all other variables are thus identical to the Nash solution. If $\gamma<1$, the optimal output for PCS rises while that of the S producers falls (as does the output of the ROW producers). The equivalence of the Nash and joint-profit equilibrium with $\gamma=1$ is somewhat surprising. As will be discussed below, this result may form one bound in a bargaining set between the government and private sector over taxes and industry output.

Cooperative Equilibria

If there is any possibility that PCS could begin acting like a dominant firm which attempts to increase its output, the previous sections illustrated that Saskatchewan private producers will suffer. An obvious question is whether private-sector producers have an incentive to collude with PCS to increase their share of the market at the expense of ROW producers. Are there any gains to partial cartelization of the potash industry in North America? While there are a number of possible behavioural assumptions that could characterize a partial cartel, two cases are examined here. The first case assumes that G and S are now Stackelberg leaders, while the ROW follows. In the second case, G and S collude, but behave as Nash competitors. In the first case, the Saskatchewan cartel maximizes

$$\hat{\pi} = (q_G + q_S)(a - bQ) \qquad (10)$$

where the ROW reaction function is now $q_R = (a-c) - (1/2)(q_G+q_S)$. The cartel's output is then (a+c). If S and PCS divide the output equally, each produces (1/2)(a+c), and again we have the same solution as the Nash base case. Another way to look at the result is that it is simply the same as the single-leader Stackelberg equilibrium, but now output must be divided up between the members in some way. The province as a whole can do no better than the Stackelberg outcome. Private Saskatchewan producers may, of course, improve their lot compared to the single-leader Stackelberg case. The key result is, however, that by looking at aggregate Saskatchewan output, one would not be able to distinguish between the "Stackelberg" cartel and the non-cooperative Nash equilibrium. And if shares of the output were split equally among all producers in the Stackelberg cartel, even mine-specific data would not tell us what type of strategy was being followed in Saskatchewan.

In the second type of cartel -- the "Nash" cartel, PCS and S producers cooperate in choosing Saskatchewan output, but the cartel does not announce its output prior to that of the ROW. Instead, the cartel behaves like a Nash oligopolist. The Nash equilibrium for what is not a duopoly are the output levels $\bar{q} = q_G + q_S$ and q_R which satisfy the reaction functions:

$$\bar{q} = a - (1/2)q_R$$

$$q_R = (a-c) - (1/2)\bar{q} \qquad (11)$$

Solving equations (11), $\bar{q} = (2/3)(a+c)$, which with equal sharing of output among G and S implies each produces $(1/3)(a+c)$. The ROW firms produce $(2/3)a - (4/3)c$. The equilibrium price is $(1/3)(a+c)$. The potash cartel decreases its output substantially compared to all other equilibria considered while the output of the ROW producers rises (see Table 10 for the numerical illustration). The market price rises, increasing the profits of the ROW producers, while the cartel's profits decline considerably. The ROW thus "free rides" on the cartel; the same result was obtained in the cartel models with a competitive fringe examined by Salant (1976) and Pindyck (1978). While the Nash cartel does not look very inviting to Saskatchewan producers in this static model, it may be more plausible in a dynamic context. If the ore reserves of the ROW producers are small (as is the case right now with the New Mexican producers), they will exhaust their reserves sooner under the Nash cartel than under the alternative equilibria. Thus the cartel may be able to act as a monopolist in the future, and greatly increase its rents. Unfortunately for Saskatchewan producers, even when New Mexico exhausts its reserves, there are other potash producers that will compete (even though they do have higher extraction and transportation costs). The Nash cartel is thus somewhat unlikely.

A "Test" of the Model

The equilibria examined above are derived from a very simple model, but one which attempts to capture some of the key characteristics of the potash industry. There are a number of exercises that could be performed with the model. Changes in any of the parameters could be examined. For example, as noted in Section 2, the potash market has gone through two cycles. Exogeneous shifts in demand can be incorporated into the model by changing the parameter a -- the intercept (assuming no changes in the underlying structure of demand which affects the slope of the demand curve). A similar exercise could be performed with changes in extraction costs or the slope parameter. Thus some "real world" situations can be incorporated into the model.

To see if the model developed in Section 3 can help ascertain what type of behaviour PCS managers may have been following since its creation, a crude "test" is performed. First, it is assumed that prior the creation of PCS, the North American potash industry was an uncoordinated oligopoly, setting output characterized by the Nash equilibrium. As noted earlier, this assumption seems quite plausible prior to and immediately after prorationing. Then, by looking at actual production, sales, and market shares, an attempt is made to see if there is any evidence that the creation of PCS has led to a new strategy and thus equilibrium solution. If PCS deviated from a Nash equilibrium to a

Stackelberg or joint profit with $\gamma<1$, their share of the potash market should change. If there is any collusion among Saskatchewan potash producers and a "Nash" cartel exists, the market shares of Saskatchewan versus ROW producers should change. However, recall that we will not be able to distinguish between the Nash equilibrium and the Stackelberg cartel or joint-profit maximum with $\gamma = 1$.

Various market share measures are used as indicators of the equilibrium concept. I have data on Saskatchewan potash production and sales by company for the period 1973-83. I have calculated PCS's share of: total output produced in Saskatchewan, total North American sales, offshore sales, and North American consumption. I also illustrate the share of Saskatchewan producers as a whole in total North American consumption of potash. The results are shown in Table 11. I will first describe the data, then discuss events in the potash markets during the period in question. It appears that PCS has decreased its share of output (slightly) and sales to North America (more so), but increased its share of Canpotex sales (substantially) compared to what the mines which now constitute PCS produced and sold prior to its formation. The increase in Canpotex sales tends to offset the decline in the North American sales. However, PCS's share of Canpotex sales peaked in 1981, and has since declined to levels below the average of the pre-PCS period.

Table 11

Market Shares of PCS and Private Saskatchewan Producers

Year	PCS Share of Total Saskatchewan Potash Production	PCS Share of Total Saskatchewan Sales in North America	PCS Share of Offshore Sales
		(Per cent)	
1984	35		
1983	32	29	42
1982	34	24	50
1981	37	28	62
1980	37	29	60
1979	40	30	54
1978	34	30	57
1977	38	33	55
1976	38	34	53
1975	34	33	39
1974	36	35	38
1973	37	34	-

Year	PCS Share of Total Saskatchewan Sales	PCS Share of NA Consumption	Total Sask Share of NA Consumption
		(Per cent)	
1984	35		
1983	34	22	76
1982	32	17	68
1981	37	20	71
1980	37	22	76
1979	36	23	76
1978	36	23	77
1977	38	24	74
1976	37	26	77
1975	35	23	71
1974	35	25	70
1973	37	31	92

Notes Market shares are compiled from data on output and sales by each company in Saskatchewan. For years prior to 1978, the figures for PCS are obtained by adding the output and sales for the mines that PCS later acquired.

The figures for 1974 and 1973 reflect production quotas during prorationing.

Source Government of Saskatchewan.

There are many factors responsible for the market shares shown in Table 11. The numbers may reflect deliberate policy objectives of PCS, but they may also be the result of a sequence of particular events. Recall that until 1975, output of each mine was controlled by prorationing. Starting in 1975, potash markets began strengthening, and PCS began production in 1977. One reason for the large increase in PCS's share of offshore markets after 1978 is the way the allocation system operates in Canpotex. Each company is guaranteed a specific share in offshore sales. When offshore markets were booming prior to 1982, some companies could not fill their quotas. The amounts remaining were made available to any other company that could ship the potash. PCS, with its increased capacity, had the potash and thus picked up a relatively large share of the offshore sales. As well, potash prices were at an all-time high (see Table 4). Thus PCS seized a good opportunity and made a substantial profit in 1980 and 1981 (see Tables 5 and 6). But when potash demand fell in 1982, these additional sales were no longer available.

An explanation for the decline in PCS's North American market share in the 1980s is that the corporation was attempting some Stackelberg strategy. A Stackelberg leader would reduce its output by more than the S or ROW producers. There would be more support for this type of strategy if the market share for all Saskatchewan producers rose from 1981-83. However, as Table 11 indicates, aggregate Saskatchewan sales as a per cent of North

American consumption fell on average after the creation of PCS. But note that there are some extreme observations. If we eliminate 1973 (a prorationing year), the share of Saskatchewan producers rose. As well, some other observers (including Anderson, 1984 and some of the references he cites), suggest that some form of dominant firm strategy could be occurring, with PCS acting as the residual supplier of potash. In my earlier work (Flatters and Olewiler, 1983), we also thought that Stackelberg behaviour might be more likely after 1980, based on the increase in PCS capacity and decline in importance of U.S. domestic producers of potash. The data suggest a possible turn to the Stackelberg equilibrium in 1982 and 1983, but after 1983, it appears the Corporation abandoned this strategy.

Offsetting this hypothesis is the fact that PCS's share of total Saskatchewan sales (offshore and North America) was virtually unchanged. The presence of PCS has probably affected many aspects of potash production and sales. However, these effects are not necessarily captured by the data on market shares. In assessing market shares and other information about the industry, it appears to me that no major sustained change in oligopoly behaviour has occurred since the creation of PCS. The decline in PCS's market share is simply too small to conclude that a change in behaviour has occurred. As well, since 1983, PCS's market shares have increased again, suggesting a return to the ratios seen previously. My conclusion is thus that there is no strong evidence to date

suggesting a sustained deviation from an uncoordinated Nash strategy.

Output and Taxes: Inferences from the Model

The model developed above can also be used to define some possible tradeoffs for the provincial government in its attempt to maximize the rents from potash production. The government now has two instruments with which to capture rent -- mineral taxes and the profits of PCS. Assuming that the government is now constitutionally able to levy taxes on mineral rents, what combination of PCS output and taxes will maximize the government's rents? The answer depends on the equilibrium strategy, legal constraints, and, of course, political factors including the relative bargaining strength of the government versus the industry over tax rates. Let us look at possible objective functions of the government in theory and see how the tax rate and PCS output will affect rents plus the profits of the private-sector firms.

The rents to the government are given by the sum of profits from PCS plus the tax revenues from all potash firms. Recall that from the provincial government's viewpoint, all private-sector firms are "foreign". The only way to capture rents is through taxation and PCS's profits. The best the government can do if it can get private firms to cooperate in setting output (and capacity) levels as suggested by the government is to follow a joint profit

strategy. This is the planning or rent-maximizing solution. This solution is a standard against which to evaluate other options. The government cannot legally operate this sort of industry "cartel". The objective function which maximizes total rents requires the government to maximize rents subject to keeping the profits of the private sector greater than or equal to some specified constant. The government simply determines the output of all Saskatchewan mines and the tax rate applied to them. The government would include a minimum profit constraint for the private sector to avoid taxing these firms at 100 per cent. No one expects that the government could carry out this plan, but it will serve as a base case in the comparison to the other equilibria.

Algebraically, the planning solution is found where

$$\hat{\pi}_G = \pi_G + t\pi_S \qquad (14)$$

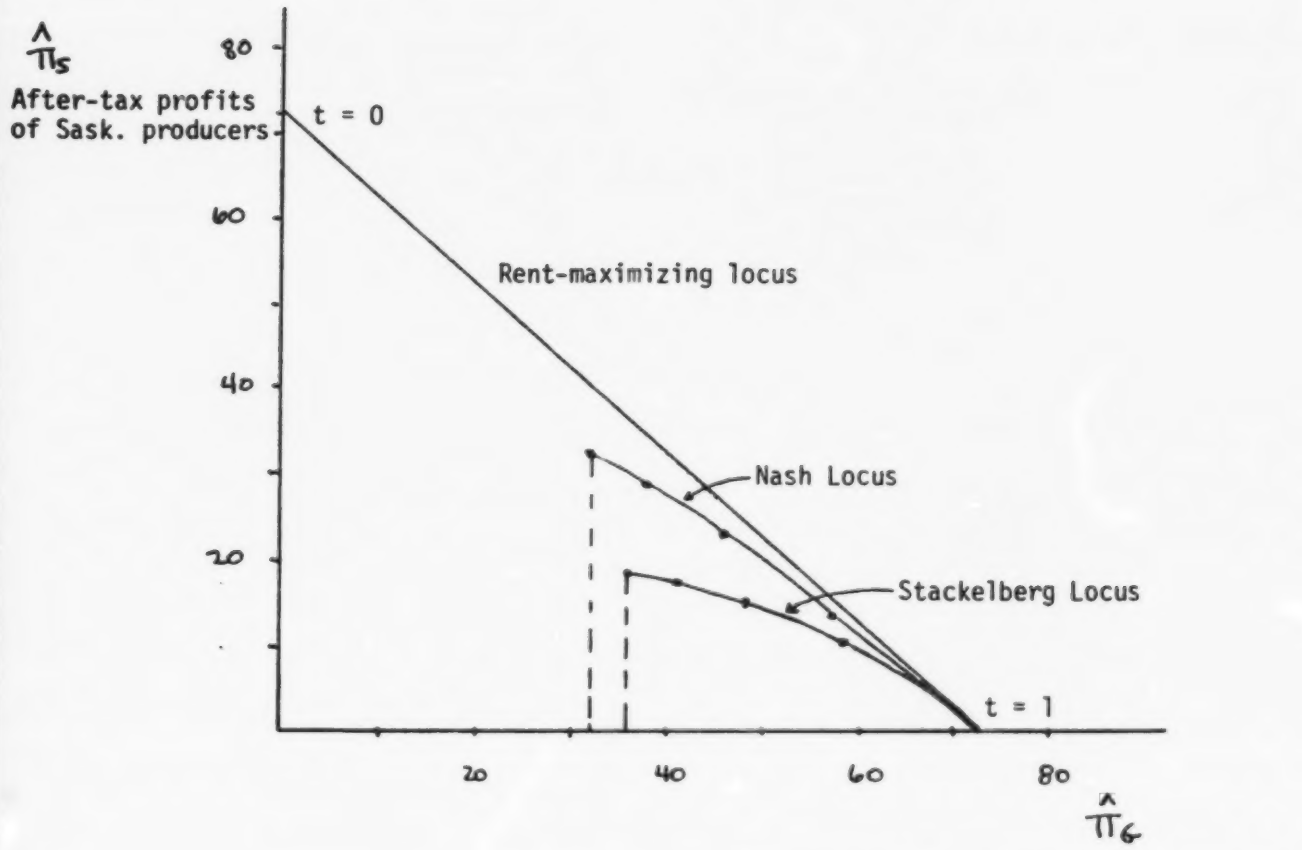
where t is the effective tax rate. In the previous section, t was the parameter γ. In this analysis, the government is levying taxes only on profits. It can, of course, also impose royalties on the value of production (or per unit produced) and fees for mineral leases if applicable. In the model that follows, a royalty on the value of production will be equivalent to a profits tax because extraction costs are assumed to be zero for simplicity. The taxes will differ in their impact in the usual case

where extraction costs are positive. The profits tax will then be a neutral tax, while the royalty on production will not. The after-tax profits of the private sector firms are given by equation (15).

$$\hat{\pi}_S = (1-t)\,\pi_S$$
$$\text{or} \quad \hat{\pi}_S = (1-t)q_S - c_S. \tag{15}$$

Figure 1 illustrates the planning solution for the Saskatchewan industry with zero extraction costs, and parameters as defined below the figure. The curve labeled the rent-maximizing locus shows the after-tax profits of the private producers versus the governments potash rents at different tax rates (ranging from 0 to 100 per cent). There is quite clearly a tradeoff between the private and public sector here. The other two curves on the figure represent the same tradeoff under the Nash and Stackelberg equilibrium concepts. These curves represent the solution of the Nash and Stackelberg equilibrium with taxes explicitly introduced using the definition of profits in equations (14) and (15). The models were solved with and without the ROW producers. The output of PCS for the two-firm model under the Nash equilibrium with taxes is $q_G = a(1-t)/(1/4)(3-t)$, while that of the S producers is $q_S = a - (1/2)q_G$. Figure 1 plots the resulting after-tax profits

Figure 1 Tax Bargaining Loci: After-tax profits of private sector potash firms versus government revenues from potash production.



$\hat{\pi}_S = (1-t)\,\pi_S$

$\hat{\pi}_G = \pi_G + t\,\pi_S$

$\pi_i = (a - bQ)q_i$ (zero extraction costs)

$Q = q_G + q_S$

$a = 12$

$b = .5$

given some arbitrary parameter values and tax rates 0, .25, .5, .75, and 1.

A similar exercise is carried out for the Stackelberg equilibrium. The equilibrium output of PCS is then given by $q_G = a(1-t)/(1/4)(2-t)$. The output of the private firms is still $q_S = a - (1/2)q_G$ if they are acting as followers in the two-firm (but not the three-firm) model. Again, the curve marked Stackelberg locus plots the after-tax profits for the same tax rates.

What this analysis suggests is that aggregate rents to both the government and private sector are the greatest under the planning solution, then decline as one moves to the Nash and Stackelberg equilibria. This is not surprising, since we know that an uncoordinated oligopolistic equilibrium can dissipate rents through potential destructive competition in output and capacity installation (see Olewiler, 1982). While the Nash locus lies above the Stackelberg one, we can see that the government's rents for each tax rate are greater under the Stackelberg case. Again, there is a tradeoff between the government's and industry's share of the rents.

The reason for doing the analysis is two-fold. First, it emphasizes that the planning solution should be calculated as a base case of strategies that maximize Saskatchewan rent. Secondly, it

illustrates the size of the pie (hypothetically) under different equilibria and for different tax rates. When the provincial government is deciding how to set taxes and determining PCS's output, this is certainly of importance.

Potential PCS Behaviour over Time

The previous section suggested the tradeoffs the provincial government could consider in determining its strategy for PCS over time. Coordination of all Saskatchewan producers would increase the potential size of potash rents to Saskatchewan residents. Others have made the same comment (Anderson, 1985a, 1985b; Barry, 1983; and those in the industry such as Paul, 1984). Coordination of both output and new capacity installations (to avoid large degrees of excess capacity) would help stabilize prices and rents, and prevent the bouts of destructive competition the industry has seen in the past. However, this coordination might lead to U.S. anti-trust litigation if it could be shown that anti-competitive practices were being followed. Coordination of capacity expansion is within the legal jurisdiction of the Saskatchewan government, but setting output targets is more questionable. Aside from legal difficulties, suppose PCS's competitors have no interest in cooperation. What should the Corporation do? Faced with the current situation of excess capacity and relatively low prices, it is clear that PCS cannot raise potash prices by reducing its output. PCS cannot succeed as a residual supplier in this depressed

market (as Saudi Arabia has discovered in the oil market). North American markets are relatively weak, and offshore markets face growing competition from other suppliers. Alternatively, PCS can strive to maintain a particular market share by aggressive marketing and price reductions. The danger with this policy is that all producers will follow suit and industry profits will stay low. It is not clear what the best strategy is for the next few years, given expected market conditions. Over the longer run, PCS should be in a relatively favourable position. Its capacity and excellent reserves should enable it to sit out the period of slack demand and be ready to supply buyers when the situation improves.

What about privatization of PCS? What would happen to Saskatchewan potash rents? PCS is undoubtedly in a better position as a large government firm to weather the downturn than it would be in the form of private firms controlling each mine separately. Saskatchewan rents are probably larger as a result. Privatization of PCS would definitely hinder moves to achieve "orderly behaviour" in the provincial industry. Without the government as a major holder of potash assets, it is difficult to see how the province could persuade private producers to act in the best interests of Saskatchewan residents. Because of limitations on its taxing authority and the very unpleasant relationships with the private sector during the "tax wars", provincial ownership of potash mines appears to be a better method of collecting resource rents from potash (when they exist) than taxation.

To date, the Devine government has not announced any explicit policies about privatization.[13] In an article this year, Saskatchewan's Minister of Finance, Robert Andrew, appears to be taking a pragmatic view of the province's role in managing Crown corporations. He acknowledges that state intervention will always occur and that government ownership of a firm per se is not the key issue. The Conservative government is assessing each of its enterprises individually, and, according to this article, no sweeping policy of privatization will be implemented. They claim to be trying to depoliticize the Crown corporations by changing management personnel. Andrew also suggests that allowing Saskatchewan residents to participate in ownership of their Crown corporations may help to depoliticize the operation of these firms. It will help avoid the criticism that the government is elitist. Andrew's term to describe the government's approach is "public participation" not "privatization". The only definitive actions taken so far have been the issue of two bonds; one for the Saskatchewan Power Corporation and the other for the Saskatchewan Oil and Gas Corporation. Employees of the Oil and Gas Corporation were given the first option on the bonds and 70 per cent of the employees participated. Andrews does not say if either of these bonds were restricted to Saskatchewan residents. The bonds are not equity instruments, of course, and we must wait to see if any sort of equity financing emerges for PCS.

Is there any way that Saskatchewan producers could become the OPEC of potash? The oligopoly model with the ROW producers suggests that any partial cartelization of producers will not increase the cartel's rents unless the non-members have a relatively small stock of potash reserves (and no new suppliers can enter). While Saskatchewan has enormous potash reserves, the ROW producers (including other Canadian producers such as New Brunswick and potentially, Manitoba) will constrain any cartel behaviour. The ROW producers may have smaller reserves and higher operating costs than Saskatchewan, but they do not represent a trivial share of world production and sales of potash.

Another point relevant to an attempt by Saskatchewan to exert market power is to recall what happens to dominant producers when demand for their product declines (or stays at low levels). In a Saskatchewan or Nash cartel, the cartel members will absorb any shortfall in demand (as residual suppliers). If potash markets are booming, it is much easier to keep the cartel together and maintain a large share of the profits.

In the case of potash, many observers are predicting growth in demand of about an average of 2 per cent per year. However, in the current economic climate, there are a number of uncertainties which will affect potash markets. On the demand side, prices for primary commodities, including agricultural goods, have remained at record lows throughout the recovery from the 1981-82 recession.

If agricultural prices do not improve, fertilizer demand is likely to suffer. Continuation of programs in the United States to reduce acreage planted (the Payment in Kind Program) may also keep potash markets in North America from rebounding strongly. However, the good news is that people need to eat. Potash is not like metals such as copper which may be facing a significant downward trend in consumption due to substitution of other materials and declining capital formation in industrial countries. As noted in section two, developing nations may provide a very strong market for potash in the future.

On the supply side, it is hard to determine what Saskatchewan producers are up against. The U.S.S.R. is the world's largest exporter of potash, but it is difficult to predict the extent to which Soviet potash will penetrate Saskatchewan's markets in the future. Soviet sales have simply been too erratic in the past to draw definitive inferences. As mentioned in Section 2, there are a number of potash deposits in the ROW which are being developed and others could be developed if potash prices rose and remained high. These deposits thus serve as a constraint on price increases possible under coordinated Saskatchewan actions. Some suppliers, notably New Brunswick and Jordan may be quite aggressive competitors. In the U.S. market, Saskatchewan has no doubt been hurt by the strength of the Canadian dollar against other foreign currencies. The exchange rate differentials have been changing and it is difficult to say where they will stabilize.

Any decrease in the relative price of Canadian dollars to other currencies will, of course, help Saskatchewan potash. Offshore potash suppliers made big inroads into the U.S. in 1982-83, prompting legislation to restrict these "cheap" sources of supply. Saskatchewan was exempt from these potential trade restrictions.

In summary, the prospects for PCS over time are far from certain. Another bout of destructive competition will not help the industry, but cooperation seems unlikely on both theoretical and practical grounds. PCS may become more aggressive in the near future to maintain its markets and sustain employment.

6 CONCLUSION

In a paper presented for a symposium on Crown corporations, McFetridge (1984, pp. 17-18) suggested the following questions form a basis for comparing the pre- and post-PCS regimes:

(1) Were the disputes over the taxation regime resolved, and, if so, did PCS play a role in the process?

(2) Did the government obtain net income from PCS which was greater than the tax and royalty income it was able to extract from the component companies prior to the formation of PCS?

(3) Did the government's royalty and tax yield from the remaining private sector producers rise?

(4) Was the government able to make PCS and the private producers adopt policies which they had previously refused to pursue?

These are excellent question that can provide a conclusion to this paper. I have shown in the paper that the answers to questions 1 and 2 are yes. The tax disputes were resolved, no doubt in part because the government now had its "window on the

industry" and much better information and understanding about potash operations and profitability. As was shown in Part 4, net income to the province was substantially above what would have been generated by taxation of the component companies alone. With regard to the third question, tax revenues from potash producers have changed substantially since PCS was created. The tax revenues were very high in the boom and are now much lower in the recession. These shifts are somewhat independent of PCS. The Potash Reserves Tax was eliminated and the PRPAs have resulted in a generally lower tax burden on the industry.[14] This change has been welcomed by most industry observers who felt that the PRT extracted too great a share of profits (it taxed more than pure rent). If so, the move to a new tax system has probably benefited Saskatchewan by improving the competitive position of its mines.

With regard to question 4, it is simply too early to tell. The mood in the province appears to be far more harmonious than in the early days of the creation of PCS. The government and private producers appear to be working together more closely. But I have been unable to discern, looking at data on output, capacity expansion plans, and so on, whether potash producers are following policies that they had previously refused to follow. There does not appear to be much change yet. One area to watch is the offshore market and PCS's role in Canpotex. The Potash Corporation of Saskatchewan has been a fascinating subject for study and is an example of how a Crown corporation can be created

out of political and economic conflict. It also shows that PCS has, on average, generated positive net benefits for the residents of Saskatchewan.

Notes

1 See Searls (1980) p. 107. Searls also contributes a general discussion of potash products, markets, sales, and other descriptive information about the industry. See Anderson (1984a) for a detailed discussion of the potash industry, and Barry (1983) for a summary of recent events.

2 Producing countries which are completely under government control include the Soviet Union, the German Democratic Republic, and China. In Canada and Spain, almost 50 per cent of potash production is under public ownership, while France, Israel, and Italy have partial government ownership. Governments are also prominent forces in the construction of new mines in Brazil and elsewhere.

3 Hereafter metric ton measures will be denoted tonnes.

4 See Fuss and Gupta (1981) for details on various functional forms which can be used in estimating cost curves.

5 This section is based on Flatters and Olewiler (1983).

6 This is a peculiar use of the technical term "dumping" in the legal documents. The Saskatchewan producers were not selling potash at a price in the U.S. less than the Canadian price. The legal challenges seem to be that Saskatchewan potash was being sold at a price in the U.S. that did not allow U.S. potash producers to make a profit.

7 For a good analysis of the two important Supreme Court decisions with respect to resource management and the new Constitutional arrangements in this regard, see the two papers by Moull (1980, 1982), and paper by Whyte (1983).

8 On October 3, 1978 the Supreme Court of Canada ruled provincial prorationing ultra vires. In part the judgement read: "it is, of course, true that production controls and conservation measures with respect to natural resources in a province are ordinarily matters within provincial legislative authority. The situation may be different, however, where a Province establishes a marketing scheme with price fixing as its central feature. Indeed, it has been held that provincial legislation authority does not extend to the control or regulation of the marketing of provincial products, whether minerals or natural resources, in interprovincial or export trade". See Barry (1979) as well.

9 It should be noted as well that the Saskatchewan government's decision not give private-sector producers permission to

expand capacity turned out to benefit the province by reducing aggregate excess capacity in the 1980s. There was some concern expressed when this decision was taken that the boom would not continue.

10 The Allan mine was not operated by PCS until 1981.

11 It has been suggested that the NDP government maintained employment at a high level during 1982 before the provincial election in that year.

12 For example, the Stackelberg equilibrium concept runs into problems of dynamic inconsistency.

13 One of the first acts of the Devine government with respect to potash was to bow to pressure by the private potash producers to keep PCS in Canpotex. See Eisler (1983).

14 Recall, however, that the federal government increased all mining firms' taxes by disallowing the deduction of provincial taxes in the federal corporate tax.

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